Honeywell

Safety Manager
Hardware Reference

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Other trademarks

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World Wide Web

Honeywell Solution Support Online:

`http://www.honeywell.com/ps`.

Training classes

Honeywell holds technical training classes on Safety Manager. These classes are taught by experts in the field of process control systems. For more information about these classes, contact your Honeywell representative, or see `http://www.automationcollege.com`.

Related Documentation

The following guides are available for Safety Manager.

The guide in front of you is *Hardware Reference*.

Guide	Description
The *Overview Guide*	This guide describes the general knowledge required, the basic functions of, and the tasks related to Safety Manager.
The *Safety Manual*	This guide describes the specifications, design guidelines, and safety aspects related to Safety Manager.
The *Planning and Design Guide*	This guide describes the tasks related to planning and designing a Safety Manager project.
The *Installation and Upgrade Guide*	This guide describes the tasks related to installing, replacing and upgrading hardware and software as part of a Safety Manager project.
The *Troubleshooting and Maintenance Guide*	This guide describes the tasks related to troubleshooting and maintaining Safety Manager.
The *System Administration Guide*	This guide describes the task related to administrating the computer systems used in a Safety Manager project.
The *Hardware Reference*	This guide specifies the hardware components that build a Safety Manager project.
The *Withdrawn Hardware Reference*	This guide specifies all withdrawn hardware components and identifies alternatives for maintaining Safety Manager projects containing withdrawn hardware.
The *Software Reference*	This guide specifies the software functions that build a Safety Manager project and contains guidelines on how to operate them.
The *On-line Modification Guide*	This guide describes the theory, steps and tasks related to upgrading Safety Builder and embedded software and modifying an application online in a redundant Safety Manager.

Task-oriented guides

A task-oriented guide provides both procedural and basic knowledge. A task can inform the reader on *how to* perform the task in terms of steps to follow. Additionally a task can describe *what* important considerations to make or what options to choose from when performing a task.

A task-oriented guide lists the required skills and knowledge that people must master to qualify for the described tasks.

It is common for task oriented guides to refer to reference guides for details.

Reference guides

A reference guide provides detailed information or solutions regarding its scope. A reference guide is a Safety Manager related guide and provides background information to support tasks as described in task-oriented guides.

A reference guide does not describe tasks in terms of *how to* perform the task in terms of steps to follow.

Available electronic format

All guides are available in two formats:

- As web pages that can be viewed in the Safety Manager Knowledge Builder; this is an Internet Explorer based viewer with extensive search and indexing options.
  The information stored on the Safety Manager Knowledge Builder CD-ROM can be installed as stand-alone or merged with other Knowledge Builder booksets on a server.
- As Adobe PDF guides that can be viewed with Acrobat Reader or a compatible reader.
  These PDF guides are also provided on the Safety Manager Knowledge Builder CD-ROM, in a separate PDF Collection folder.

Conventions

Symbols

The following symbols are used in Safety Manager documentation:

Attention

This symbol is used for information that emphasizes or supplements important points of the main text.

Tip

This symbol is used for useful, but not essential, suggestions.

Note

This symbol is used to emphasize or supplement important points of the main text.

Caution

This symbol warns of potential damage, such as corruption of the database.

Warning

This symbol warns of potentially hazardous situations, which, if not avoided, could result in serious injury or death.

ESD

This symbol warns for danger of an electro-static discharge to which equipment may be sensitive.

Fonts

The following fonts are used in Safety Manager documentation:

Emphasis • "... inform the reader on *how to* perform the task in terms of..." • "...see the *Overview Guide*"	*Emphasised text* is used to: • emphasise important words in the text, • identify document titles.
Label "The **Advanced** tab of the **Properties** dialog has.."	This font is used to identify labels and titles of (popup) dialogs. **Labels** are used for Dialog box labels, menu items, names of properties, and so on.
Steps Take the following steps: **1. Create a plant and set its properties.** **2. ....**	This font is used to identify steps. **Steps** indicate the course of action that must be adhered to, to achieve a certain goal.
`User Variable` ..create the ***`My Projects`*** folder and store the ***`readme.txt`*** file here. ..press the ***`Tab`*** key.. Next press ***`Enter`*** to..	This font is used to: 1. identify a user variable, a filename, an object or view. 2. highlight the keys the user should press on the keyboard. ***`User variable`*** is a variable, an object or a view that the reader can call-up to view or to manipulate.
`Value` "`Low` is the fault reaction state for digital inputs and digital outputs."	This font is used to indicate a value. `Value` is a variable that the reader must resolve by choosing a pre-defined state.
`Variable` "The syntax is: ***`filename`*** *`[-s] [-p]`*"	This font is used to identify a variable. *`Variables`* are used in syntax and code examples.
`http://www.honeywellsms.com`	This font is used to identify a URL, directing a reader to a website that can be referred to.

Contents

The *Hardware Reference* 1

The *Hardware Reference* is intended primarily for the people responsible for and performing tasks related to Safety Manager.

This guide provides technical information and specifications for all hardware components used in conjunction with Honeywell SMS's Safety Manager.

Typical readers are hardware engineers, maintenance engineers and assembly personnel.

It is assumed that the reader masters the required skills and knowledge as described herein.

This section contains the following information about this Guide:

Note

This guide does not contain information related to other Honeywell Experion™ PKS systems and third-party controllers such as Allen-Bradley, Series 9000, TDC 3000, Data Hiway, UDC, PlantScape, and so on.

For information about these systems, see the manufacturers book set.

Content of *Hardware Reference*

The *Hardware Reference* is a reference guide providing detailed information regarding technical information and specifications for all hardware components used in conjunction with Honeywell SMS's Safety Manager.

A reference guide is a Safety Manager related guide and does not describe tasks in terms of *how to* perform the task in terms of steps to follow. A reference guide can provide input to support decisions required to achieve a certain objective.

Additionally the following information is presented:

References

The following guides may use this reference guide as a reference source:

Guide	Description
The *Overview Guide*	This guide describes the general knowledge required, the basic functions of, and the tasks related to Safety Manager.
The *Safety Manual*	This guide describes the specifications, design guidelines, and safety aspects related to Safety Manager.
The *Planning and Design Guide*	This guide describes the tasks related to planning and designing a Safety Manager project.
The *Troubleshooting and Maintenance Guide*	This guide describes the tasks related to troubleshooting and maintaining Safety Manager.
The *System Administration Guide*	This guide describes the task related to administrating the computer systems used in a Safety Manager project.

Basic skills and knowledge

Before performing tasks related to Safety Manager you need to:

- Understand basic Safety Manager concepts as explained in the *Overview Guide* and the *Glossary*.
- Have a thorough understanding of the *Safety Manual*.
- Have had appropriate training related to Safety Manager that certifies you for your tasks (see the *Planning and Design Guide*).

Prerequisite skills

When you perform tasks related to Safety Manager, it is assumed that you have appropriate knowledge of:

- Site procedures
- The hardware and software you are working with. These may i.e. be: computers, printers, network components, Controller and Station software.
- Microsoft Windows operating systems.
- Programmable logic controllers (PLCs).
- Applicable safety standards for Process & Equipment Under Control.
- Application design conform IEC 61131-3.
- The IEC 61508 and IEC 61511 standards.

This guide assumes that you have a basic familiarity with the process(es) connected to the equipment under control and that you have a complete understanding of the hazard and risk analysis.

Training

Most of the skills mentioned above can be achieved by appropriate training. For more information, contact your Honeywell SMS representative or see:

- `http://www.automationcollege.com`.

Safety standards for Process & Equipment Under Control (PUC, EUC)

Safety Manager is the logic solver of a Safety Instrumented System (SIS) performing specific Safety Instrumented Functions (SIF) to ensure that risks are kept at predefined levels.

A SIS measures, independently from the Basic Process Control System (BPCS), a couple of relevant process signals like temperature, pressure, level in a tank or the flow through a pipe. The values of these signals are compared with the predefined safe values and, if needed, the SIS gives an alarm or takes action. *In such cases the SIS controls the safety of the process and lowers the chance of an unsafe situation*.

The logic in Safety Manager defines the response to process parameters.

In this context the following terms are explained in this section:

- Safety Integrity Level (SIL)
- Safety layers of protection
- Equipment Under Control (EUC)
- Process Under Control (PUC)

Safety Integrity Level (SIL)

The IEC 61508 standard specifies 4 levels of safety performance for safety functions. These are called safety integrity levels. Safety integrity level 1 (SIL1) is the lowest level of safety integrity, and safety integrity level 4 (SIL4) the highest level. If the level is below SIL1, the IEC 61508 and IEC 61511 do not apply.

Safety Manager can be used for processing multiple SIFs simultaneously demanding a SIL1 up to and including SIL3.

To achieve the required safety integrity level for the E/E/PE safety-related systems, an overall safety life cycle is adopted as the technical framework (as defined in IEC 61508).

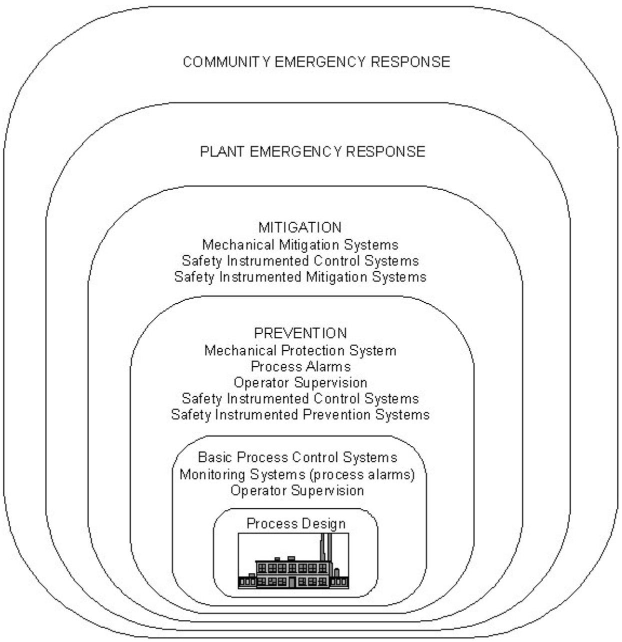
Safety layers of protection

Figure 1 on page 6 shows the typical risk reduction methods or safety protection layers used in modern process plants.

Safety Instrumented Systems (SIS) are designed to operate in the prevention and mitigation layers to:

- Prevent a process from entering a dangerous state.
- Mitigate the consequences of entering a dangerous state.

Figure 1 The concept of layers of protection



Equipment Under Control (EUC)

Safety-related systems, such as Safety Manager, are designed to prevent the EUC from entering a dangerous state and to mitigate any EUC that has gone into a dangerous state.

For these functions a safety related system can be split in:

- Emergency shutdown systems, operating in the prevention layer of Figure 1 on page 6.
- Fire and gas detection and control systems, operating in the mitigation layer of Figure 1 on page 6.

Process Under Control (PUC)

PUC is EUC expanded with regulations to prevent the process from running out of control or to mitigate the consequences when it does run out of control.

Where PUC is concerned, Safety Manager monitors the process for abnormal situations. Safety Manager is able to initiate safety actions and process alarms.

Such actions and alarms can be caused by abnormal situations in the:

- Process
- Safety loops
- Safety system itself.

General information

2

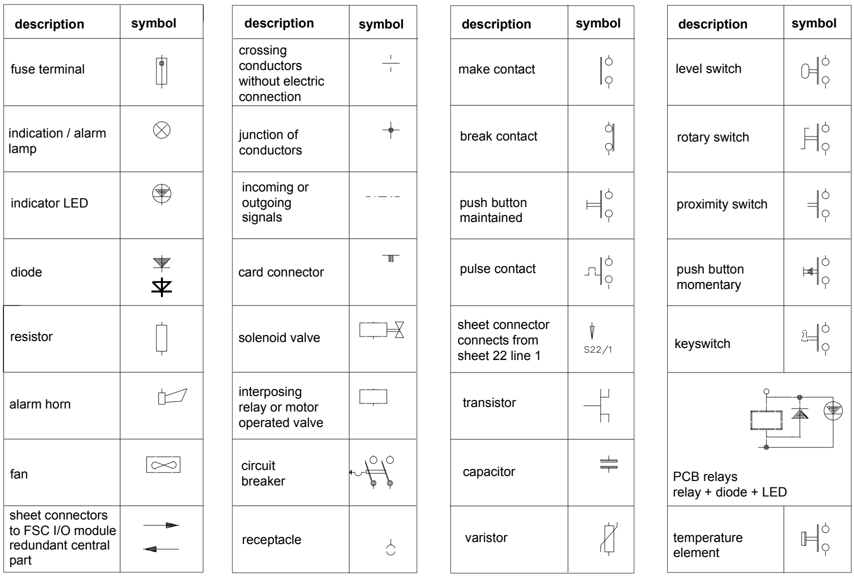
This chapter describes the following items:

Legend of symbols

Description

This guide contains layout diagrams and wiring examples. The figure below explains some specific symbols used in these diagrams.

Figure 2 Symbols used in this guide



Safety Manager operating conditions

Safety Manager cabinets

Safety Manager cabinets are generally encased in steel cabinets for mechanical protection of the electronic equipment. Compliance with CE directives further requires Safety Managers to be properly covered.

Safety Manager main components

Safety Manager typically consists of the following main components:

- Cabinet enclosure.
- Power supply system consisting of power supply units (PSUs) generating 24 Vdc (and 48 Vdc or 110 Vdc if needed), main switches and power distribution rails.
- Controller chassis with QPPs, communication modules, 5V supply modules and a Battery and Key switch module.
- Input/output chassis with all input and output modules.
- Field termination assemblies (FTAs) and/or terminals.

Safety Manager operating conditions

Attention:

Below conditions assume that proper airflow is provided (i.e. fans and louvre filters are fitted and operational).

The conditions required for proper Safety Manager operation are as follows:

- Storage temperature: –40°C—+85°C (–40°F—+185°F)
- Operating temperature:
  - Safety Manager cabinet –5°C—70°C (23°F—158°F)[1]
  - SM remote cabinet –40°C—70°C (–40°F—158°F)[2]
- Relative humidity: 5%—95% (non-condensing)

- Vibration (sinusoidal): Excitation: sine-shaped with sliding frequency
  Frequency range: 10—-150 Hz
  Loads:
  10 Hz — 57 Hz: 0.075 mm
  57 Hz — 150 Hz: 1 G
  No. of axes: 3 (x, y, z)
  Traverse rate: 1 Oct./min.
- Shock: 15 G in 3 axes (shock duration: 11 ms).

1 Measured in the Control Processor modules at 24 Vdc supply voltage.
2 Measured in the SM universal IO modules at 24 Vdc supply voltage.

Supply voltages

The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 Vdc: +25% / –15%
- 48 Vdc: +15% / –15%
- 24 Vdc: +30% / –15%

Notes:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the SM Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the SM Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

Safety Manager environment

The most common environment for a Safety Manager cabinet is an air-conditioned equipment/control room.

If the Safety Manager cabinet is to be used in an outdoor environment, special attention should to paid to:

- minimum and maximum ambient temperatures
- humidity
- protection grade (IP grading).

Standards compliance

This sub section provides a list of the standards Safety Manager complies with.

Table 1 Safety Manager compliance to standards

Standard	Title	Remarks
IEC 61508, Part 1-7 (2010) (S84.01)	Functional safety of electrical/electronic/ programmable electronic (E/E/PE) safety-related systems.	Values such as PFD, PFH and SFF can be provided upon request.
IEC 61511-1 (2004) (S84)	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements	
IEC 62061 (2005)	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	
ISO 13849-1 (2008)	Safety of machinery - Safety related parts of control systems. General principles for design	
EN 54 part 2 (2006)	Components of automatic fire detection systems, Introduction.	
EN 954-1 (1996)	Safety of Machinery - Safety Related Parts of Control Systems - Part 1. General Principles for Design	
EN 50130-4 (2003)	Electromagnetic compatibility - Immunity for requirements for components of fire, intruder and social alarm systems.	
EN 50156-1 (2004)	Electrical equipment of furnaces.	
EN 60204-1 (2009)	Safety of machinery - Electrical equipment of machines - Part 1: General requirements	
IEC 61000-6-2 (2005)	Electromagnetic compatibility – Generic immunity standard: Industrial environment.	

Table 1 Safety Manager compliance to standards

Standard	Title	Remarks
IEC 61010-1 (2010)	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements.	
IEC 61131-2 (2007)	Programmable controllers. Part 2: Equipment requirements and tests.	
IEC 61326-3-1 (2008)	Immunity requirements for safety related systems.	
NFPA 72 (2010)	National Fire Alarm Code Handbook	
NFPA 85 (2011)	Boiler and Combustions Systems Hazards Code	
NFPA 86 (2011)	Standard for Ovens and Furnaces	
UL 508	Industrial control equipment, seventeenth edition.	Underwriters Laboratories.
UL 508A (2001)	UL Standard for Safety Industrial Control Panels	Underwriters Laboratories.
FM3600, FM 3611 Class I, Division 2, Groups A, B, C & D Class II, Division 2, Groups F & G	Electrical equipment for use in • Class I, Division 2, • Class II, Division 2, and • Class III, Division 1 and 2, hazardous locations.	Factory Mutual Research. Applies to the field wiring circuits of the following modules: SDI-1624, SAI-0410, SAI-1620m, SDIL-1608 and SAO-0220m, and installation of the Controller in these environments.
CSA C22.2	Process control equipment. Industrial products.	Canadian Standards Association No. 142.
IEC 60068-1 (2004)	Basic environmental testing procedures.	
IEC 60068-2-1	Cold test. (undervoltage)	Safety Manager; -5°C (23°F) SM universal IO module; -40°C (-40°F) 16 hours; system in operation; reduced power supply voltage: (–15%): U=20.4 Vdc or (–10%): U=198 Vac.

Table 1 Safety Manager compliance to standards

Standard	Title	Remarks
IEC 60068-2-1	Cold test. (nominal)	Safety Manager; -10°C (14°F) SM universal IO module; -45°C (-49°F) 16 hours; system in operation.
IEC 60068-2-2	Dry heat test.	up to 70°C (158°F) 16 hours; system in operation; increased power supply voltage: (+30%): U=31.2 Vdc or (+10%): U=253 Vac.
IEC 60068-2-3	Test Ca: damp heat, steady state.	21 days at +40°C (104°F), 93% relative humidity; function test after cooling.
IEC 60068-2-3	Test Ca: damp heat, steady state.	96 hours at +40°C (104°F), 93% relative humidity; system in operation.
IEC 60068-2-14	Test Na: change of temperature – withstand test.	–25°C—+55°C (–13°F—+131°F), 12 hours, 95% relative humidity, recovery time: max. 2 hours.
IEC 60068-2-30	Test Db variant 2: cyclic damp heat test.	+25°C - +55°C (+77°F - +131°F), 7days, 80-100% relative humidity, recovery time: 1 - 2 hours.

Table 1 Safety Manager compliance to standards

Standard	Title	Remarks
IEC 60068-2-6	Environmental testing – Part 2: Tests – Test. Fc: vibration (sinusoidal).	Excitation: sine-shaped with sliding frequency; Safety Manager: Frequency range: 10 - 150 Hz. Loads: • 10 - 57 Hz; 0.075 mm. • 57 - 150 Hz; 1 G. Duration: 10 cycles (20 sweeps) per axis. No. of axes: 3 (x, y, z). Traverse rate: 1 oct/min in operation. SM universal IO module Frequency range: 3 - 150 Hz. Loads: • 3 - 8.4 Hz; 3.5 mm. • 8.4 - 150 Hz; 1 G. Duration: 10 cycles (20 sweeps) per axis. No. of axes: 3 (x, y, z). Traverse rate: 1 oct/min in operation.
IEC 60068-2-27	Environmental testing – Part 2: Tests – Test. Ea: shock.	Half sine shock. 6 shocks per 3 axes (18 in total). Maximum acceleration: 15 G. Shock duration: 11 ms. Safety Manager in operation.

Key coding

Introduction

A Safety Manager cabinet typically contains two types of modules:

- Control Processor modules (see “Control Processor modules” on page 237)
- IO modules (see “Input modules” on page 289 and “Output modules” on page 343)

Control Processor modules

Control Processor modules must be placed in pre-defined locations inside the Controller chassis (for more information see “Chassis” on page 85). These locations are identical for all configurations. In some configurations, not all positions need to be filled (dummy casings or a cover plate may be used instead).

IO Modules

The locations of the IO modules inside the IO chassis (for more information see “Chassis” on page 85) are not pre-defined. They are defined by the user in the Hardware Configurator option of the Safety Builder software. To ensure proper interfacing with the field devices (wiring, etc.) and to prevent damage to equipment, the IO modules must remain in their designated location. Insertion of a module in a slot that was intended for an other type of IO module, can result in defects to this module and/or the connected field devices. To prevent this, each IO module has two holes in unique positions in its rear connector. Coding pins are inserted at the corresponding locations in the IO backplane connector, so each slot in the IO chassis can only accept the correct type of IO module.

Note

For key coding, use SOURIAU make 5159.009.17.22 pins and the special insertion tool, type 5159.009.96.

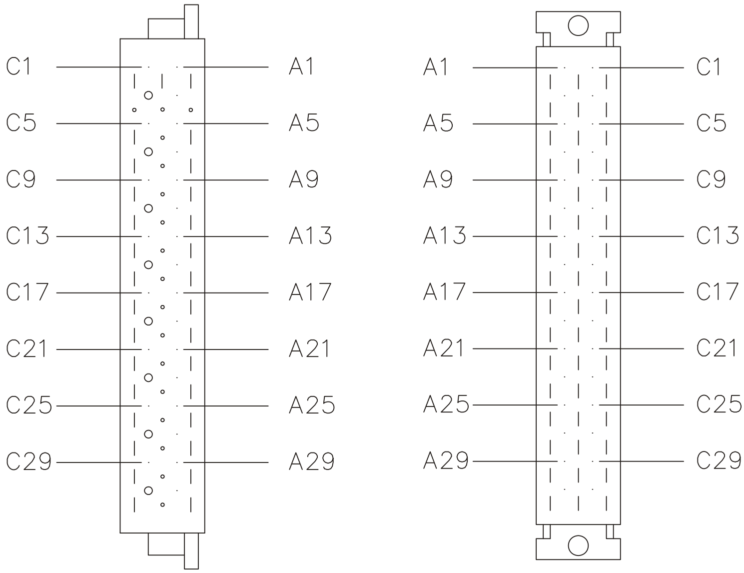
If the coding pins of the module are bent, they must be removed. If you try to bend the pins back to their correct position, they will break and the connector will then need to be replaced.

Connectors

Every IO module has a connector that is plugged into the appropriate chassis connector and a flatcable with connector (on the front side) that must be placed in the bus-print at the front of the IO chassis.

Figure 3 on page 18 shows the layout of the module connector and chassis connector for IO modules. It clearly indicates the positions for the coding holes (in the module connector) and the coding pins (in the IO backplane connector).

Figure 3 IO module connector (left) and IO chassis connector (right)



module connector *chassis connector*

Safety Manager IO modules are coded with coding system type 5159, make SOURIAU. Table 2 on page 18 shows the key coding positions for all key coded modules.

Table 2 Key coding positions for all possible key coded modules

Module type	Module hole positions		Chassis pin positions	
	Hole 1	Hole 2	Pin 1	Pin 2
Input modules				
SDI-1624	A5	C5	A5	C5
SDI-1648	A13	C29	A13	C29
SAI-0410	A5	C17	A5	C17
SAI-1620m	A5	C25	A5	C25
SDIL-1608	A5	C29	A5	C29
Output modules				
SDO-0824	A9	C9	A9	C9

Table 2 Key coding positions for all possible key coded modules *(continued)*

Module type	Module hole positions		Chassis pin positions	
	Hole 1	**Hole 2**	**Pin 1**	**Pin 2**
SAO-0220m	A9	C5	A9	C5
DO-1224	A9	C13	A9	C13
RO-1024	A9	C17	A9	C17
DO-1624	A9	C21	A9	C21
SDO-04110	A13	C25	A13	C25
SDO-0448	A13	C21	A13	C21
SDO-0424	A13	C5	A13	C5
SDOL-0424	A13	C9	A13	C9
SDOL-0448	A17	C9	A17	C9
Various modules [1]				
IO-0001	A5	A7	A5	A7

1 IO-0002 uses no key coding, but uses different connectors.

Type number identification

This section describes the identification method for type numbers of Safety Manager products. This method is in line with Honeywell SMS standards.
Type number identification is done in such a way that several aspects of a specific product can be recognized. For instance the functionality of the module, how it is connected (terminated) and applicable power details are coded and included in the product type number.

Identification

A type number consists of several coded elements. These elements are pre-defined and controlled by Honeywell SMS product management.
Identification of elements is done at two different levels; these levels are listed below.

1. Main elements at type-number level.

   Each type number has three main elements: <Prefix> - <Module> <Suffix>.
   Each element represents a distinct aspect of the module.
   For more information, see Identification of type numbers - main elements.

2. Sub elements at module level.

   A module element consists of several sub elements. Each element represents a distinct aspect of the module.
   For more information, see Identification of modules - sub elements.

Identification of type numbers - main elements

Main elements - overview

Main elements of a type-number are: <Prefix> - <Module> <Suffix>.

Example

FC - SDI-1624 V1.1 where:

- <Prefix> = FC — for more information see Prefix code - explained,
- <Module> = SDI-1624 — typical combination of sub elements; for more information see Identification of modules - sub elements,
- <Suffix> = V1.1 — for more information see Suffix code - explained.

Prefix code - explained

As a rule, Honeywell SMS products have type numbers that start with a distinct prefix. In this way products related to Safety Manager can always be recognized directly in overall Honeywell SMS product listings.
The prefix codes listed below apply:

<ID>	Value	Explanation
<Prefix>	FS	For non-conformal coated products
	FC	For conformal coated products
	FA	For products that can be connected to devices in explosive atmospheres
	FN	For products that are certified for Naval environments.

A prefix code must be included in the type number wherever a type number is used. However, in some cases the prefix may be excluded if the type number including the prefix becomes too long.

A prefix can be omitted in the following cases:

- type number printed on IO module front,
- type number printed on IO converter modules.

Suffix code - explained

The suffix code is to identify changes to Safety Manager products.

The format of the suffix code is as follows:

- "V#.#" (for example: V1.1).

Identification of modules - sub elements

Safety Manager products serve a variety of functions and are divided into typical groups of modules. These groups are represented in the chapters of this guide. To support and identify the various aspects for all groups of modules a master set of coded sub elements exists. This master set dictates the meaning of each sub element and the sequence they appear in.
Each group of modules has its own typical sub-set of sub elements. The meaning of the elements that are used and the sequence they appear in is dictated by the master set of coded sub elements. Any particular module within a group uses one or more of the elements of that typical sub-set of sub elements.

Integrity of this identification method and its application requires full support of all people involved. Requests and proposals for new modules and groups of modules must be directed to the product manager of Safety Manager.

Sub elements - overview

The table below shows the master set of coded sub elements in the heading. The table rows show the typical sub-sets of sub elements per group of modules.

All groups of modules	t	s	f	ta	-	ch	e	-	v1	v2	c	-	n	o	/	Lx
Chassis			f		-		e						n	o		
Power supplies	t	s	f	ta	-		e	-	v1	v2	c		n	o		
Control Processor modules			f		-		e						n			
Input modules		s	f		-	ch			v1		c			o		
Input converter modules	t	s	f		-	ch		-	v1		c			o		
Output modules		s	f		-	ch			v1		c			o		
Output converter modules	t	s	f		-	ch	e	-	v1		c			o		
Universal IO modules	t	s	f		-	ch		-	v1							
IO busses			f		-		e						n			
FTAs [1] for standard functions	t	s	f		-	ch		-	v1		c			o		
FTAs [1] for special functions	t	s	f		-	ch		-	v1	v2	c			o		
FTAs [1] for communication purposes	t		f		-		e									
IOTAs [1] for remote applications			f	ta	-	ch	e	-	v1							
Field Terminal Solutions	t		f		-								n			
System Interconnection Cables			f		-								n		/	Lx
Communication Cables			f		-		e	-					n		/	Lx
Power distribution			f		-	ch	e		v1		c	-	n	o		
5V and watchdog distribution			f		-		e		v1		c	-	n	o		

1 FTA stands for: Field Termination Assembly. IOTA stands for: IO Termination Assembly.

Sub elements - explained

The table below gives a list of the coded **Sub element**s within the master set. Per sub element an explanation is given, and also additional details when applicable.

Sub element	Explanation	Additional details
t	Termination method.	
s	SAFE module.	
f	Function of the module.	
ta	Termination method for remote modules.	
-	Standard divider.	Only applied when applicable.
ch	Number of channels.	Specified in two digits.
e	Extended function.	
-	Standard divider.	Only applied when applicable.
v1	Voltage (primary or single).	Specified either as UNI or in two digits.
v2	Voltage (secondary).	Specified in two or three digits.
c	Current.	Specified in two digits.
-	Standard divider.	Only applied when applicable.
n	Number.	Providing a sequential number of 1 to 4 digits.
o	Optional suffix.	
/	Special divider.	Applied when a cable length is specified.
Lx	Length in meters.	Applied when a cable length is specified.

Examples

This sub section provides examples of typical module identification. For each group of modules an example is given.

Specific information about groups of modules and individual modules is included in this guide. Each group of modules has a dedicated chapter.

Each chapter contains data sheets of the relevant modules, and where applicable a sub section with general information aimed at that group.

The title of a data sheet only provides the main element of the module. The sub-title provides the name and function of the module. See Figure 4 on page 24.

Figure 4 Data sheet - module identiffication in title and sub-title

SDI-1624

SDI-1624

Safe digital input module (24 Vdc, 16 channels)

The full type number (or type numbers) is (are) specified in the topic **Technical data**. See Figure 5 on page 24.

Figure 5 Data sheet - Type number identification in Technical date

SDI-1624

Technical data

The SDI-1624 module has the following specifications:

General	Type numbers[1]:	FS-SDI-1624 V1.0
		FC-SDI-1624 CCV1.0

The table below gives an example per group of modules. For each example module element the module name and function is given.

All groups of modules	Example module element	Module name and function
Chassis	CPCHAS-0002	Chassis for redundant Controller (Safety Manager A.R.T.)
Power supplies	PSU-UNI2450U	25—28 Vdc Power supply (1200 W) – UL508 approved
Control Processor modules	QPP-0002	Quad Processor Pack
	Note: The Power Supply module within this group is the exception to the rule. Naming of this module will be in line with the naming convention for Power supplis.	
Input modules	SDI-1624	Safe digital input module (24 Vdc, 16 channels)
Input converter modules	BSN-1608	Digital converter module for Safety sensor signals (16 channels)
Output modules	SDOL-0424	Safe loop-monitored digital output module (24 Vdc, 1 A, 4 channels)
Output converter modules	BSDOL-04UNI	Range setting module
Universal IO modules	RUSIO-3224	Remote Universal Safe IO device (32 channels, 24 Vdc)
IO busses	FS-IOBUS-CPIOX	IO bus in extension cabinet
FTAs for standard functions	TSAI-1620M	Safe 0-20 mA and 4-20 mA analog input FTA (16 channels)
FTAs for special functions	TSHART-1620M	Safe 0-20 mA and 4-20 mA analog input FTA with HART interface (16 channels)
FTAs for communication purposes	DCOM-232/485	RS232/485 communication FTA
IOTAs for remote applications	IOTA-R24	Redundant IO Termination Assembly
Field Terminal Solutions	TERM-NAMUR-01	NAMUR to 0-20mA analog-IN converter terminal
System Interconnection Cables	SICC-0001/L50	System Interconnection Cable terminating on FTAs (SICC)
Communication Cables	CCE-485-05/L10	External communication cable
Power distribution	PDB-0824P	Power Distribution Board (24Vdc, 2 Amp, 8 channel)
5V and watchdog distribution	PDC-CPX05	Power Distribution Board Controller cabinet (5 Vdc, Watchdog)

Handling and ordering spare parts

3

This section provides information on handling and ordering of emergency spare parts. It covers the following topics:

Topic	See
Handling of defective products or parts	page 28
Ordering of emergency replacements	page 30

In these topics the following terminology is used:

Products

Products are defined as hardware or software designed, manufactured and sold by Honeywell SMS.

Parts

Parts are single components from which products are manufactured.

Defects

Defects are a non-functionality in a product or part.

Repeatable defect

Repeatable defect is a non-functionality of a product or part which originates from the design or manufacturing specification.

Emergency replacements

Emergency replacements are products or parts required for the replacement of defective products or parts during a Factory Acceptance Test (FAT) at Honeywell premises and field defects which need emergency replacement. The quantities for emergency replacements are typically small and these parts may **NOT** be used for expansion or modification!

Handling of defective products or parts

Returning goods

Defective products and parts can be returned for repair to a local affiliate of Honeywell. They forward the defective products and parts to the global repair center.

Identification

The defective product or part shall be clearly identified with:

- Model number
- Serial number
- Description of the defect (for example the diagnostics)
- Shipping address
- Contact person

The product or part must be clearly marked as defect.

Analysis

The global repair center analyzes the returned product or part. On receipt the repair center verifies if the product or part:

- Is under warranty.
- Is defective.
- Can be repaired.

Repair

The product or part will be repaired only if it is economically justifiable. This depends on the cost estimate analysis:

- The sender will be notified if the repair costs are too high.
- If the costs are too high, the defective part will only be returned to sender on specific request and at the cost of the sender.

Invoices

The local affiliate will invoice the sender if the warranty period for the part has expired for:

- The amount of the repair costs (these never exceed the costs of a new module).
- Shipment costs.

Repair cost estimate

Before a part is actually shipped for repair, a repair cost estimate may be requested from the local affiliate.

Repaired product or part return

Repaired parts will be returned to the sender's address unless specific shipping instructions specify otherwise.

If the delivery address differs from the invoice address, a pro-forma invoice will be added to the delivery documents for custom clearance. A repair report is a standard component of the shipment. All deliveries are ex works Honeywell.

Time to repair

On receipt of a defective part, a receipt notification is issued to the sender which includes an estimated repair time.

The normal repair time for Safety Manager parts is four weeks after receipt at the global repair center. The repair time of non-Safety Manager parts or equipment depends on the repair times of their suppliers.

Emergency replacements

Emergency replacements can be ordered using the procedure described in the related procedure.

For details see "Ordering of emergency replacements" on page 30.

Ordering of emergency replacements

Requests

Requests for emergency replacements must go through the local affiliate of Honeywell.

Fax

Requests for emergency replacements must be submitted by means of a fax message which clearly indicates “EMERGENCY REPLACEMENT REQUEST”. The fax must at least state the following:

- Model number
- Purchase order number
- Description
- Quantity
- Originator
- Shipping address
- Warranty replacement status
- Model and serial number of the defective part if it is a warranty replacement

Shipment and documents

The shipment of the emergency replacements is accompanied for custom clearance by a pro-forma invoice and a shipping note stating that it is a repair replacement. All deliveries are ex works Honeywell.

Invoice

An invoice is sent to the requester based on the project price for the requested parts, plus the shipping cost.

Credit note

On receipt of defective items at the global repair center, a credit note of 25% of the price is submitted, if the defective item can be repaired.

Beyond repair

If it turns out that a returned product or part cannot be repaired, the requester will be informed and no credit note will be submitted.

Warranty

The local affiliate checks if the returned item is still under warranty. In that case, a credit note of 100% of the price will be submitted.

Return of defective product or part

The defective product or part must be returned to the local affiliate of Honeywell.

Cabinet

4

The following topics are described in this section:

General info

This chapter describes standard cabinets that are available for Safety Manager systems.

Using standard cabinets provides several advantages over specifically designed cabinets. Honeywell SMS policy is aimed at delivering standard engineered, tested and certified (modular) concepts to the market for these main reasons:

- Reusing existing concepts saves valuable time (e.g. engineering, testing, certification).
- Individual projects will be delivered at a guaranteed level of quality and in short turn-around times.
- Applying modularity within a proven overall concept provides for flexibility toward customers.

Typically, Safety Manager is installed in a standard cabinet. It is possible to add or rearrange certain components or change their location within the cabinet.

Also, standard SM remote cabinets are available. Depending on specific application needs one or more types can be opted for.

Should you not wish to follow the standard cabinet layout, then you can only do so after prior consult with Honeywell SMS.

Rittal TS

Standard Rittal enclosure for Safety Manager

Description

The standard enclosure for Safety Manager is based on two cabinet types available in the Rittal TS 8 series.

Safety Manager enclosures are default equipped with a swing frame, support glands, fans, an enclosure frame with steel doors, louvres and filters, an enclosure light, a thermostat, earthing strips, a mounting plate, gland plates, a rear panel and a roof or bottom plate. Side panels are mounted to the outer walls.

A standard Safety Manager enclosure is painted in RAL 7035, with RAL 7022 for the plinth.

Below sections provide more details related to the Rittal TS series as assembled and delivered by Honeywell SMS.

Cabinet enclosure

Roof	Suitable for mounting the Honeywell SMS fan unit (HU-511/HU-611) (see section "Fans" on page 38).
	An earth strap makes an earth connection from the roof to the cabinet (connected to the left hand earth bolt on the roof).
	For top cable entry, use one of the following standard Rittal roofs: For TS 8806 cabinet: roof type DK 7826.863, For TS 8808 cabinet: roof type DK 7826.883. These roofs are equipped with a fixed and a sliding part, each with a clamping strip for optimum sealing.
Side wall plates	Mounted to the outer side walls.
Rear wall	Mounted in cabinets with front access only. The standard installed earth potential equalization points are sufficient to ensure proper earth connection.
Bottom plates	Can be moved horizontally when unlocked.
Gland plates	Used for cable entry at the bottom of the cabinet. Earthed to the cabinet frame.

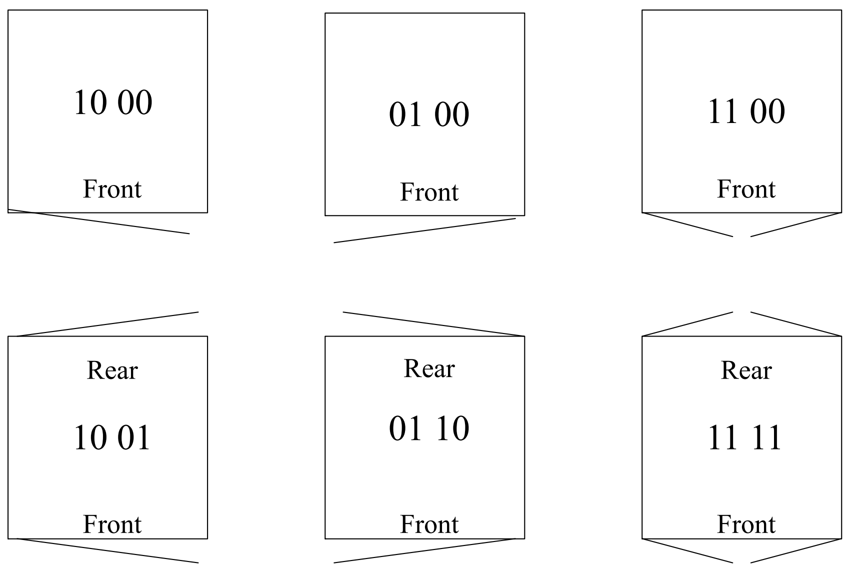
Cabinet access

A Safety Manager cabinet can have front access or combined front and rear access (when it is not placed against a wall). The following table shows the possible configurations for cabinet doors:

	Front door	Rear door	Code in figure below
Front access only	Single, hinged left	-	1000
	Single, hinged right	-	0100
	Double	-	1100
Front and rear access	Single, hinged left	Single, hinged right	1001
	Single, hinged right	Single, hinged left	0110
	Double	Double	1111

Please note the following issues:

- A combination of single (full) door and double (half) doors is not possible.
- Double (half) doors for rear entry can only be selected if double (half) doors are selected for front entry.
- Single (full) rear door, hinged on the left hand side can only be selected if a single (full) front door, hinged on the right hand side is selected.
- Single (full) rear door, hinged on the right hand side can only be selected if a single (full) front door, hinged on the left hand side is selected.



Cabinet doors

Item	Amount	Remarks
Hinge	4 Per door	130° (internal) door hinges are used.
Comfort handle	1 Per door	
Comfort handle insert (key type)	1 For each door handle	If a push button door lock is required, this will have to be ordered separately.
Earth strap	1 Per door	Mounted on the top side of the door.
Louvres	2 Per front/rear side	See “Louvres and filters” on page 37.
Wiring plan pocket (A4)	1	1 Piece per cabinet enclosure, only on front side doors, placed inside the (left hand) door.
Doorstop		Mounted on the inside of a single door (hinged left) to prevent it from colliding with the opened swing frame.

Louvres and filters

In the lower part of the cabinet doors, louvres and filters are mounted to allow for airflow inside the Safety Manager cabinet, in one of two ways:

Single (full) door	Each door is fitted with two louvres with filters. The louvre, including filter, is a Rittal type SK 3323.200.
Double (half) door	Each door is fitted with one louvre with filter. The louvre, including filter, is a Rittal type SK 3323.200.

Cabinet swing frame

The cabinet swing frame, which is always hinged at the left hand side, contains the following Safety Manager components:

Controller chassis	Typically located 3 HE below the top position in the cabinet.
IO chassis	Typically located directly below the Controller chassis.
Bus bar for 24 V power	Typically mounted vertically, right from the various chassis.
Cable tray for vertical bus	Typically mounted vertically, left from the various chassis.
Swing frame stop	Mounted on bottom of swing frame.
Mounting kit	Top and bottom mounting plate for 180 deg. swing frame hinge.

Earth strap	2, One at the top and one at the bottom of the swing frame.
Ergoform S-handle with push lock	No additional swing frame stops are required during normal transportation.
Captive nuts	121 captive nuts, installed on the front and rear side of the swing frame.

It is not necessary for every cabinet to contain a swing frame. When two cabinets are attached mechanically to each other, the:

- Left-hand side cabinet houses the Controller (and contains the swing frame).
- Right-hand side cabinet is meant for marshalling the connections with the field (and doesn't contain a swing frame).

Enclosure light

The Rittal enclosure light (PS 4155.000) has an auto-select input voltage detector (110/230 Vac) and is equipped with a motion sensor. You no longer require an additional door switch. If the shipping section consists of more than one Rittal cabinet enclosure, all cabinets will have an enclosure light. All enclosure lights use the same feeder. The feeder is wired from the first cabinet (with an interconnection cable) to the second and, if applicable, from the second to the third cabinet, etc.

Fans

A pair of fans are mounted in the roof. The following types are available:

- Papst, type 4184NX, operating voltage 24 Vdc
- Honeywell SMS fan unit which can be delivered in 3 voltages 24 Vdc, 115 Vac, and one for 230 Vac. For a data sheet of the 24 Vdc fan unit see "FS-FANWR-24R" on page 41.

  The Honeywell SMS fan units consist of a pair of fans. A read-back contact indicates the operational status of the fans.

Thermostat

The thermostat gives an alarm to alert you of temperature increasing inside the Safety Manager cabinet (e.g. when filters are blocked or fans fail). When a Honeywell SMS fan unit is installed, the thermostat is not required.

The Rittal SK 3110.000 thermostat is mounted on the top right-hand side of each Rittal cabinet and is suitable for temperatures ranging from +5°C—+55°C (+41°F—+131°F).

Support structures

A Safety Manager cabinet comes fitted with the following support structures:

Structure	Description
Rittal mounting rails	For non-FTA use. For example: mounting of SIC strain relief brackets and cable trays for communication cables. • Type TS 8612.180 (for 800 mm deep cabinets), • Type TS 8612.160 (for 600 mm deep cabinets).
TS 35 rail	Used for FTAs, terminals, filters, etc.
FTA channels	For FTAs, channels are the preferred solution.
Cable support/ clamp rails	Typically installed at the bottom and/or top, depending on cable entry. Used for securing field cables with cable clamps during on-site cabinet installation. Clamping devices must be able to withstand a 45 kg (100 lbs) pull. If a plinth is factory-mounted and the cabinet has bottom cable entry, the cable support/clamp rail is mounted in the plinth.
Mounting plates	For the mounting of power supply units.

Earthing

Earth rail / potential equalization rail	An earth rail / potential equalization rail is always mounted. The required number of earth rails / potential equalization rails depends on the equipment mounted inside the cabinet enclosure.
Safety earth bar	Mechanical items are connected via the Rittal cabinet frame to the safety earth bar. These are mechanical items such as the swing frame, mechanical items in the swing frame, door(s), side wall/plates, roof, bottom plates, the rear wall (if applicable) and all other items requiring a connection to the safety earth bar.
Instrument earth bar	The instrument earth bar is mounted isolated from the cabinet frame and other earth bars.

Ingress Protection (IP) rating

By default, Safety Manager cabinets have an IP rating of IP20 in accordance with DIN VDE 0470.

Electrostatic Discharge (ESD) Bonding point

An ESD bonding point is fixed to the cabinet chassis.

General data

Cabinet types	Rittal TS 8806	One of the two standard Rittal cabinet types is used for Safety Manager cabinets.
	Rittal TS 8808	
Approvals	IP 20 / NEMA1	
Color	RAL 7035	Light grey, used for the cabinet enclosure.
	RAL 7022	Dark gray, used for the plinth.
Dimensions Heights do not include the plinth (normally 10 cm / 4 in) and the lifting eye-bolts (5 cm / 2 in).	80 × 60 × 200 cm (31½ × 23½ × 78¾ in) (width × depth × height)	Rittal TS 8806
	80 × 80 × 200 cm (31½ × 31½ × 78¾ in) (width × depth × height)	Rittal TS 8808
Weight	up to 550 kg (1210 lbs)	Weight of cabinet filled with electronics (depends on options used).
Hoisting eye bolts	4	Rittal type PS 4568.000 Placed on the top corners of the cabinet, used for crane transportation of the cabinet and for securing the roof to the cabinet.
Plinth	height: 10 cm (4 in)	Standard (factory mounted) the Safety Manager cabinet is supplied with a plinth, unless specified otherwise in the customer requirements.
Leveling feet		If leveling feet are required, use a Rittal standard cabinet without a plinth.

FS-FANWR-24R

Fan unit 24 Vdc with readback

Description

The 24 Vdc fan unit (FS-FANWR-24R) consists of two fans and a printed circuit board (PCB) 07209 on a mounting plate.

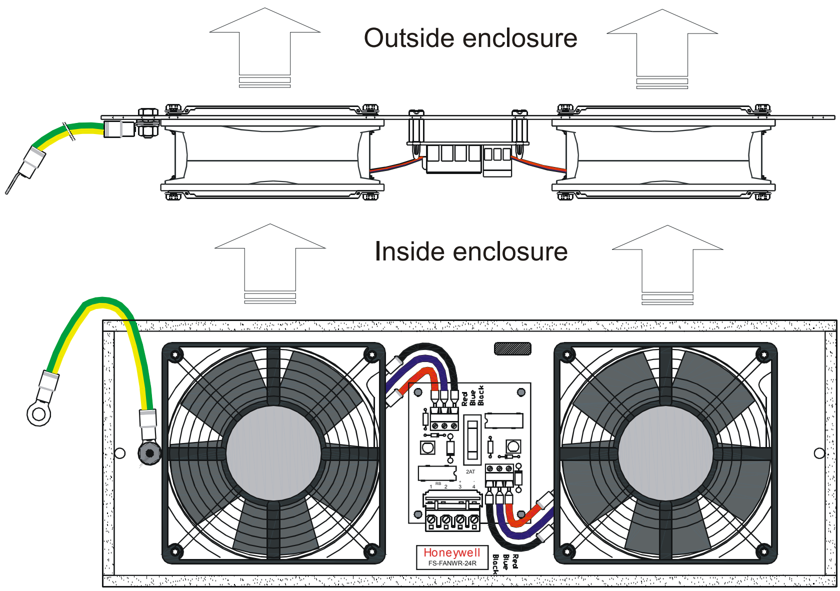
The external 24 Vdc power and readback contact wiring for the fan unit terminates on a 4 pole connector which slots into the fan unit.

Electronics in the fan unit generate the signals to indicate the fan status. If the speed of a fan is above minimum, a green LED next to that fan illuminates to indicate this. If both fans are above minimum speed the readback contact closes.

Finger guards are mounted on both sides of the fans.

Figure 6 on page 41 shows the direction of airflow and the bottom and side view of the fan unit.

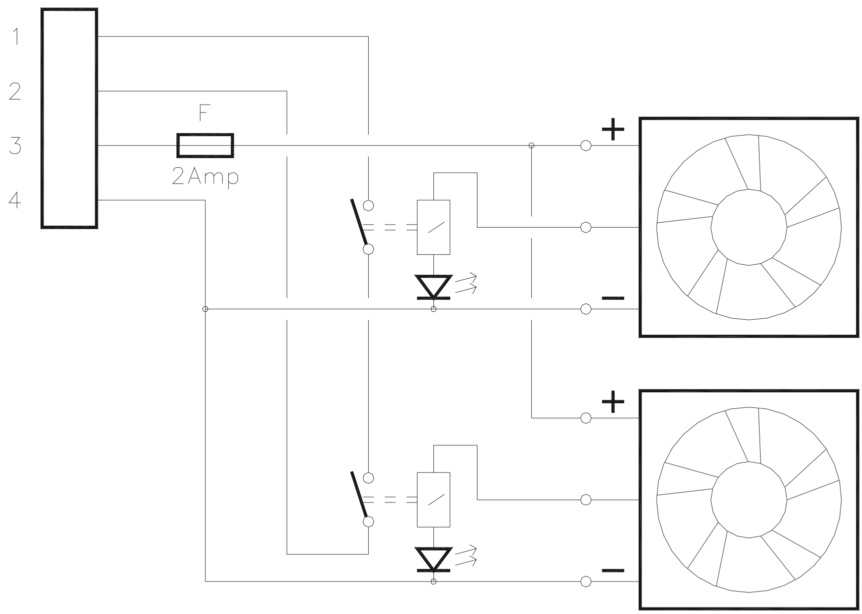
Figure 6 Layout of the FS-FANWR-24R fan unit and direction of air flow



Block diagram

Figure 7 on page 42 shows a functional block diagram of the FS-FANWR-24R fan unit.

Figure 7 functional block diagram of the FS-FANWR-24R fan unit



Fan status indication

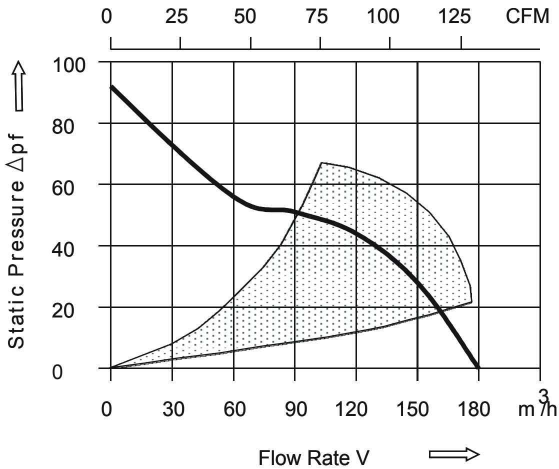
The fan unit is equipped with a potential free readback contact and green LEDs to indicate the fan status.

- The readback contact is closed for about 15 seconds during powerup and when the rotation speed (RPM) of *both* fans is above the minimum speed.
- A LED is on when the rotation speed (RPM) of the *related* fan is above the minimum speed.

Flow rate / Static pressure

Figure 8 on page 43 shows the flow rate *per fan* against the static pressure. The grey area indicates the optimum operating range.

Figure 8 Flow rate against static pressure (per fan)



Electrical connection

Attention:

The earth wire of the fan unit must be connected to the enclosure in which the fan unit is mounted.

The fan unit is equipped with a 4 pole screw connector to wire the readback contact and the 24Vdc power.

Figure 6 on page 41 shows the location of the connector on the fan unit. Figure 9 on page 43 shows the connection details of this connector.

Figure 9 The FS-FANWR-24R fan unit connector details

Mounting

Attention:

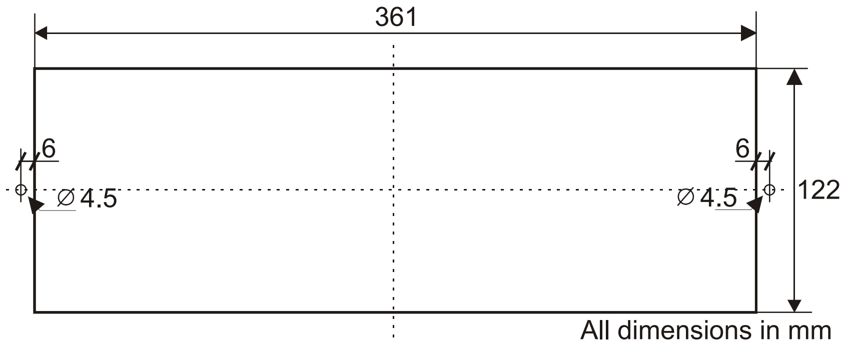
The airflow through the fan unit should not be obstructed on either side of the unit in order to ensure proper functioning of the fan unit.

The fan unit can be mounted in horizontal or vertical position.

The fan unit needs to be mounted in such a way that the fans and electronics are inside the enclosure. The fan unit will then generate an under pressure inside the enclosure.

Figure 10 on page 44 shows the required cut-out opening of the fan unit and the location of the mounting holes.

Figure 10 Cut-out plan of the fan unit including mounting holes



Technical data

The FS-FANWR-24R has the following specifications:

General	Type numbers	FS-FANWR-24R
	Approvals:	CE, UL; FM pending
Model and make	Fan make: Model:	Papst 4184N/17X (ball bearing)
	Finger guard make: Model:	Papst LZ30
Power	Power requirements:	24 Vdc 9.5W
	Voltage range:	12—29 Vdc No reverse polarity protection
Fuse	Fuse rating:	2 A slow
	Measurements:	5 x 20 mm
Air flow	(for the complete unit)	360 m^3/hr., 211.8 CFM
Noise	(for the complete unit)	52 dB
Fan speed	Nominal speed:	3.200 RPM
	Minimum speed: (to close readback contact)	1.500 RMP ± 100 RPM
Life cycle		85.000 hrs at 40°C (104°F) 37.500 hrs at 75°C (167°F)
Ingress protection		IP 20
Temperature range		–30°C — +75°C (–22°F — +167°F)
Readback contact	max. switched voltage:	300 Vdc / 240 Vac
	max switched current:	0.5 A
	max. switched power:	10 W
Connector	wire stripping length:	7 mm
	Tightening torque:	0.4—0.5 Nm
	type of screwdriver:	SD 0.6 X 3.5 – DIN 5264
Physical	Dimensions:	391 × 142 × 51 mm (L × W × D) 15.4 × 5.59 × 2.01 in (L × W × D)
	Weight:	1.7 kg

RUSFDU-01

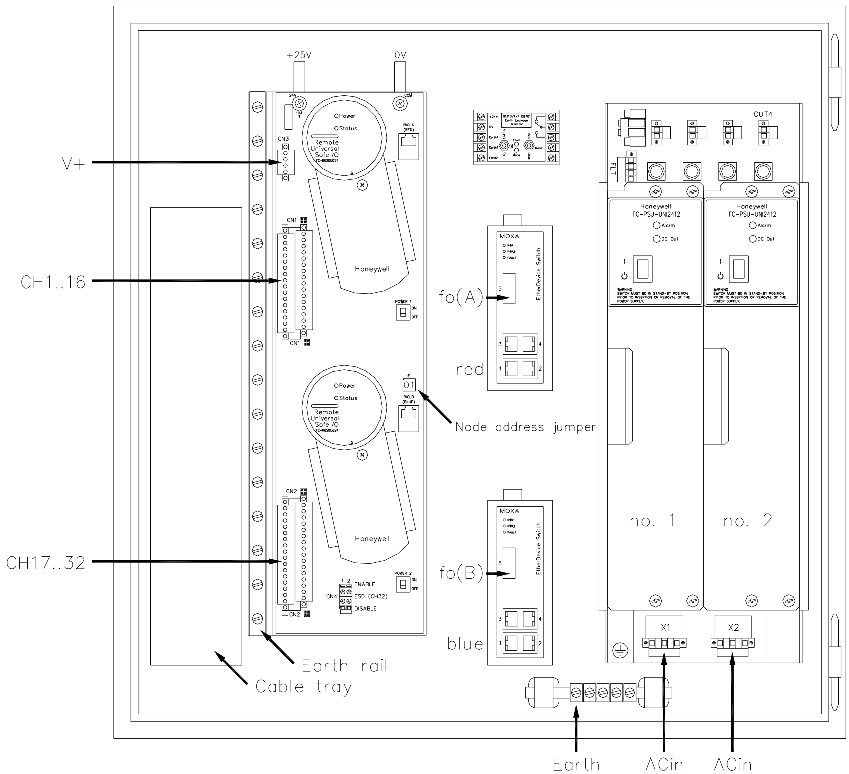
Remote Universal Safe Field Device Unit (type 01)

Description

The RUSFDU-01 is a (600 x 600 x 210 mm) cabinet that can be placed in the field. It has 32 universal safe IO channels that are controlled by a SM Controller. The RUSFDU-01 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

Figure 11 on page 46 shows a (simplified) frontview of the RUSFDU-01 cabinet with the door removed.

Figure 11 Front view

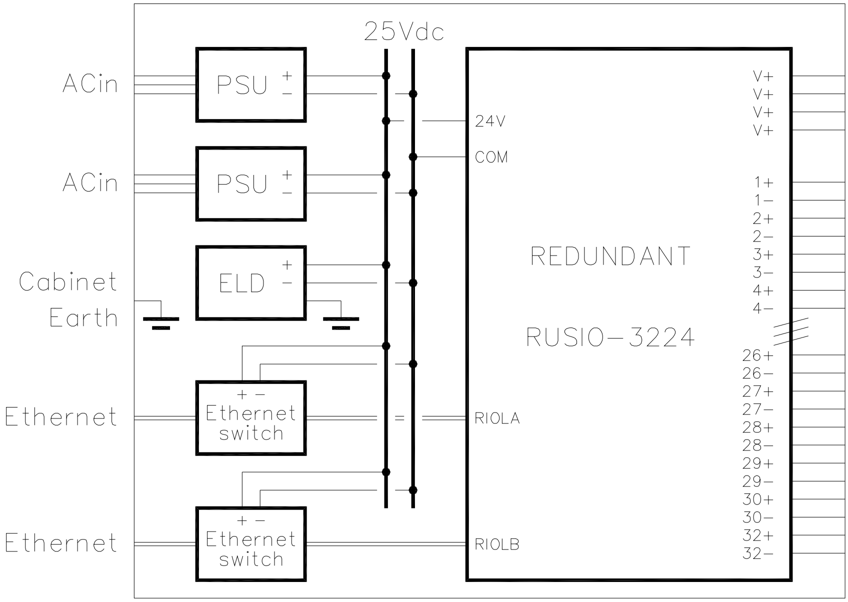


The RUSFDU-01 has the following features:

- It is powered with a (pair of) 120Vac or 230Vac feeder(s).
- It can supply up to 9 Amps of (24Vdc) field load.
- It has an Earth Leakage Detector (ELD) that detects leakage current between the 25Vdc supply and (the cabinet) earth.
- It requires a redundant Ethernet connection of 100 Mbaud to the Safety Manager Controller (dedicated RIO link).

Figure 12 on page 47 shows a simplified block-diagram of the RUSFDU-01.

Figure 12 Block diagram



Universal safe IO channels

The RUSFDU-01 has 32 redundant universal safe IO channels. Channel 31 is used as (common) status input for the PSU, Ethernet switch and ELD status contacts.
The function of other channels can be configured. This is done in Safety Builder.

All channels use the internal 24Vdc supply (without galvanic isolation).

All channels have two connections:

- an (active) plus connection
- a minus connection, directly linked to 0V

Each channel can be configured as:

- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring)
- Analog input (0-20mA or 4-20mA active)
- Analog output (0-20mA or 4-20mA active)

The IOTA-R24 module has two switches (**POWER 1** and **POWER 2**):

- **POWER 1** switches the power for the top RUSIO-3224 module (Module 'A')
- **POWER 2** switches the power for the bottom RUSIO-3224 module (Module 'B')

Each RUSIO-3224 module has two LEDs; one for power indication and one for status indication.

The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

Channel connections

Channel 1 thru 16 on CN1

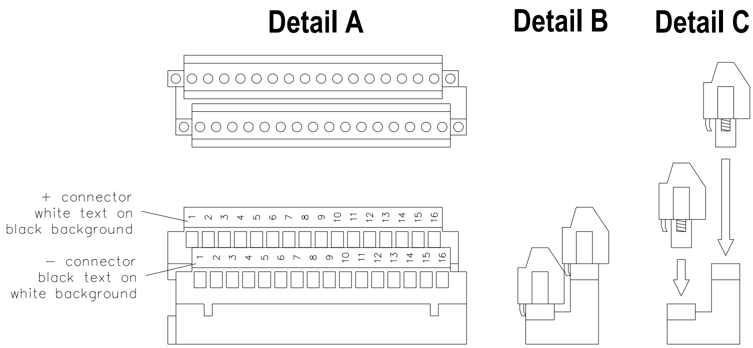
IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 13 Channel 1 thru 16 on CN1



Channel 17 thru 32 on CN2

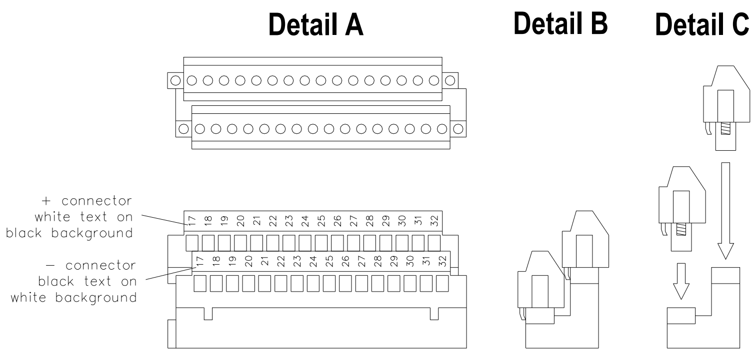
IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 14 Channel 17 thru 32 on CN2



V+ connections on CN3

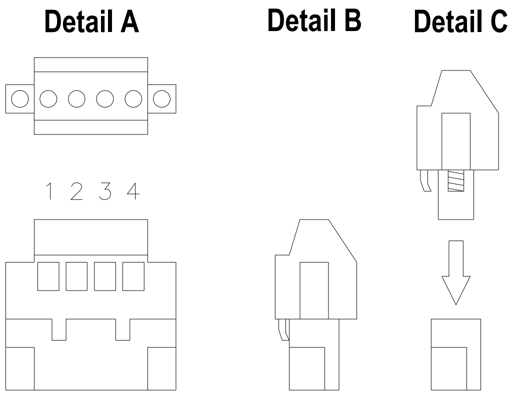
CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

Figure 15 V+ connections on CN3



For further details on the channels, the modules and the mounting assembly, see the datasheets of the RUSIO-3224 module and the IOTA-R24 module.

Earth rail

On the left of CN1 and CN2, there is an earth rail for field cable shield termination.

Redundant 25Vdc power supplies

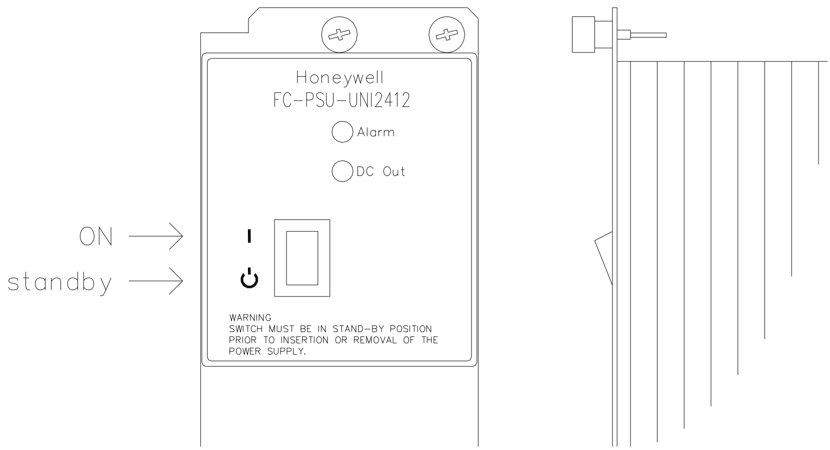
The RUSFDU-01 has two PSU-UNI2412 power supplies.
They can provide 25Vdc, 12 A (out of 120Vac or 230Vac line power).

The PSU-UNI2412 power supply has the following hardware control features:

- An ON/Standby switch
- Two LEDs for status indication,
  one for **Alarm** and one for **DC Out** indications
- Output over voltage protection (OVP)
- An alarm contact (for status)

Figure 16 on page 51 shows a detail of the PSU with the switch and the leds.

Figure 16 PSU-UNI2412 - detailed views



ON/Standby switch

The ON/Standby switch has two positions. The side view on Figure 16 on page 51 shows the stand-by position.

Warning:

The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

PSU Status indications

The **Alarm** LED is:

- Off when the unit is OK or has no power (on AC input)
- Red when the unit is powered (on AC input) but the 25V output is not OK (e.g. because the switch is in the stand-by position)
- Red and blinking when the internal temperature > 90 degC

The **DC Out** LED is:

- green when the 25V output voltage is OK (>22V)
- off when the 25V output voltage is lost

POWER IN connectors

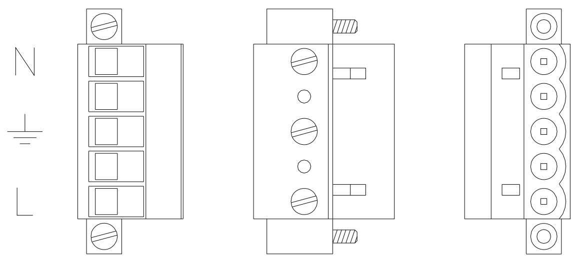
See the figure below for a top, side & bottom view of the POWER IN connectors.

The two (110Vac or 230Vac) POWER IN connectors (**X1** and **X2**) are situated on the lower side of the PCB.

The pin assignment of connectors **X1** and **X2** is:

- pin 5: Neutral (N)
- pin 3: Ground
- pin 1: Line (L)

Figure 17 POWER IN connectors X1 and X2



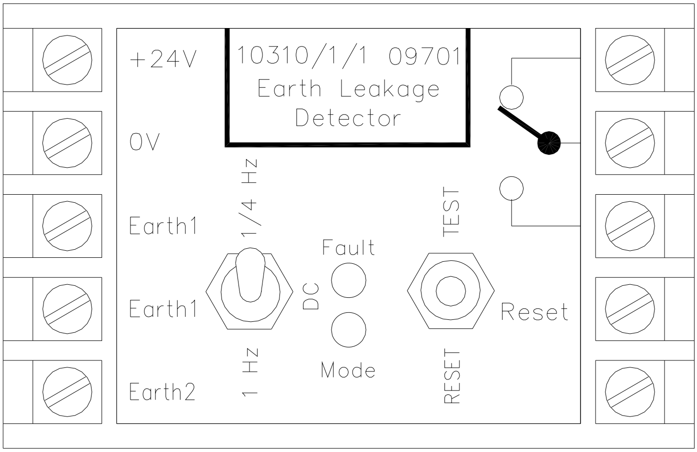
For further details about the power supplies, see the datasheets of the PSU-UNI2412 module and the PSUTA-0001 module.

Earth leakage detector

The 10310/1/1 module is an Earth Leakage Detector (ELD) for 24Vdc systems. It detects current leakage from the local 25Vdc to (cabinet-) earth. After detecting an Earth leakage, the fault indication (led and relay) stays latched untill reset. The 10310/1/1 module has a manually operated self-test & fault-reset feature.

Figure 18 on page 53 shows the top of the ELD module with the switches, the leds and the connections.

Figure 18 10310/1/1 ELD - top view



The ELD has two leds.

The **Fault** led is:

- Red when an Earth leakage current is detected
- Off when no Earth leakage is detected (or supply power is lost)

The **Mode** led is:

- Steady green in normal mode (power is on; the mode-switch in the DC position)
- Flashing at 1/4 Hz (power is on; the mode-switch in 1/4 Hz position)
- Off when the power is off (or lost)

The status relay is activated when the power is OK and no Earth fault has been detected. The 1/4 Hz position of the mode switch is used for locating earth fault. To locate earth faults, you need to use a current clamp (such as the DCM300E digital clamp from AVO International).

For further details about the ELD, see the data sheet of the 10310/1/1 module.

Ethernet switch

The (100 Mbaud) MOXA Ethernet switches are of type number:
EDS-305-S-SC-HPS.
They have one FO-channel (glass-fiber with SC connector) and four CAT5PLUS STP (shielded twisted pair) channels (with RJ45 connector).
Channel 1 is connected with the local RUSIO-3224 modules.

The top Ethernet switch is connected to the top RUSIO-3224 module (using a cable with red connectors).
The bottom Ethernet switch is connected to the bottom RUSIO-3224 module (using a cable with blue connectors).

The connections to the SM Controller must use the glass-fiber channel (channel 5). The only exception is a RUSFDU-01 that is close to and in the same building as the SM Controller.
Channel 2, 3 and 4 can be used to connect with other RUSFDU-01 units, provided they are nearby and in the same building.

For further details about the MOXA Eternet switch, see the EDS-305 data sheets at www.moxa.com.

Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.
The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.
For an example of a node address jumper see Figure 19 on page 54.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

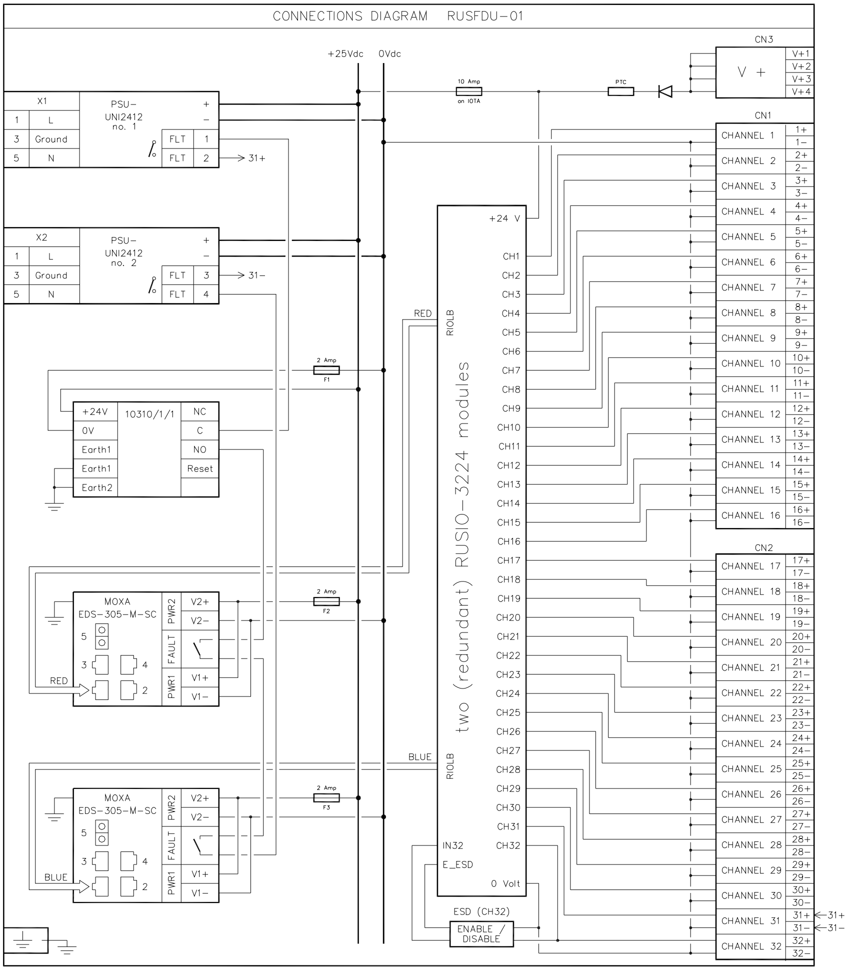
Figure 19 Node address jumper - front and side view

Note: Jumpers are not part of the scope of the RUSFDU-01 cabinet.

Connections

The connection diagram of the RUSFDU-01 is as follows:

Figure 20 Connection diagram



Mounting

Installation

The RUSFDU-01 cabinet can be mounted in one of the following ways:

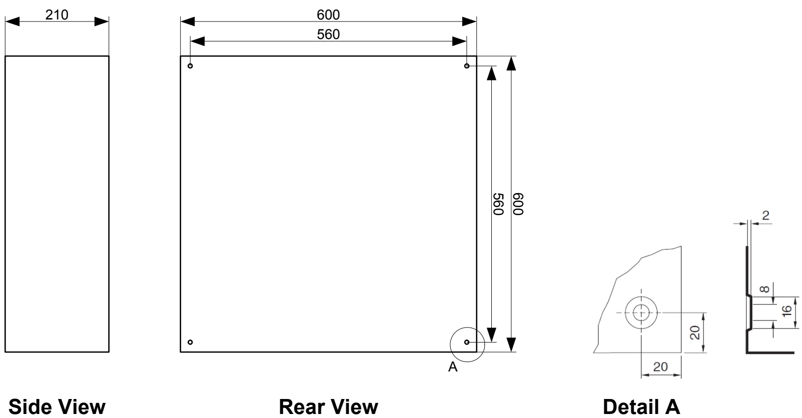
- screwed on a flat surface,
- wall mounted, using wall mounting brackets,
- frame-mounted, using wall mounting brackets; it may be necessary to make adaptions to the existing frame first.

Attention:

The RUSFDU-01 cabinet must be mounted so that the power supply units and SM universal IO modules are in upright position.

Figure 21 on page 56 shows the mechanical dimensions of the cabinet and the coordinates of the (four) mounting holes.

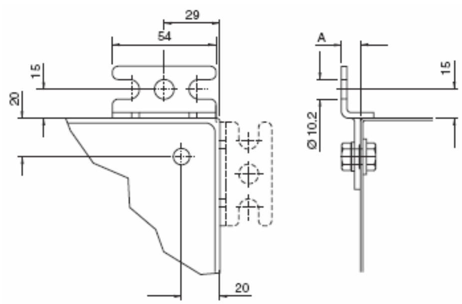
Figure 21 RUSFDU cabinet - dimensions and coordinates [1]



1 dimension are given in millimeters (mm)

Wall mounting brackets are available at manufacturer Rittal (type SZ 2503.000). See Figure 22 on page 57 for a detailed view.

Figure 22 Wall mounting bracket - detailed view [1]



1 dimension are given in millimeters (mm)

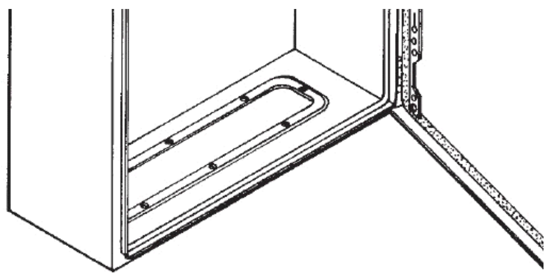
Note: Brackets are not part of the scope of the RUSFDU-01 cabinet.

Cable management

By default the RUSFDU-01 cabinet has a solid Rittal gland plate (type SZ 2560.150). During installation holes must be drilled for the cable glands that are applied.

A metal gland plate with pre-punched holes is also available at manufacturer Rittal (type SZ 2563.100).
See Figure 23 on page 57 for an example of the default gland plate.

Figure 23 Default gland plate

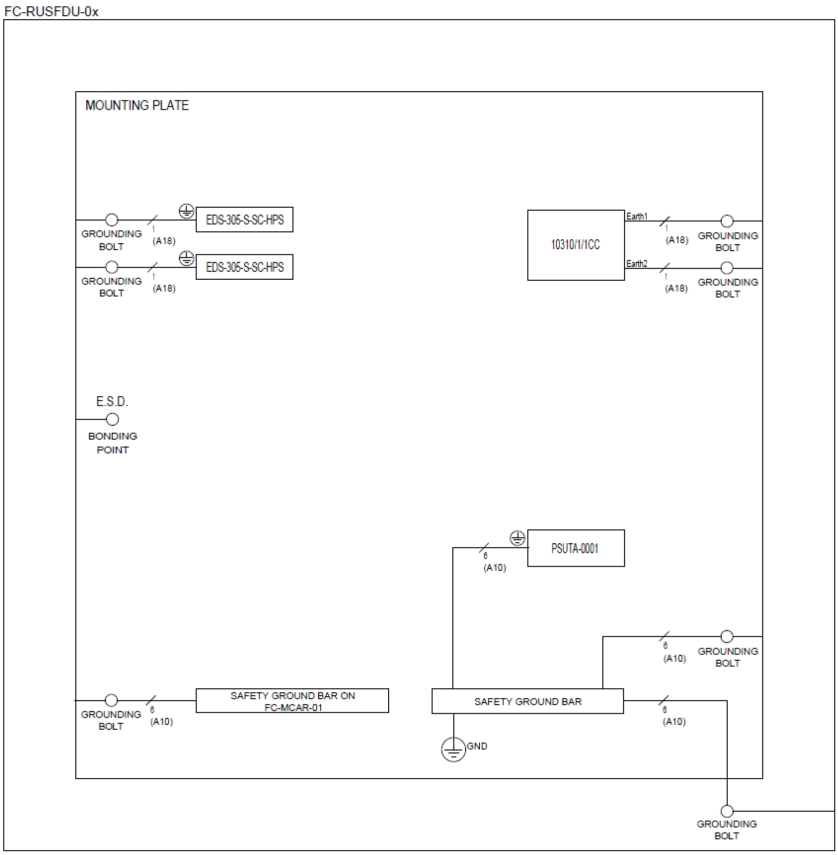


Note: SZ 2563.100 is not part of the scope of the RUSFDU-01 cabinet.

Earthing

Figure 24 on page 58 shows the earthing arrangement of the RUSFDU-01 cabinet.

Figure 24 RUSFDU cabinet - earthing arrangement



Note: the door is connected to the safety ground bar, using a 6 mm^2 (A10) ground strap.

Bill of materials

Table 3 on page 59 gives an overview of those parts of the RUSFDU-01 cabinet that can be ordered separately for spare parts, if required.

Table 3 RUSFDU-01 - spare parts list

Quantity	Order number	Description
2	FC-RUSIO-3224	SM universal IO module, 32 channels, 24 Vdc
1	FC-IOTA-R24	SM universal IO redundant IO termination assembly
1	FC-MCAR-01	SM universal IO 18 inch carrier
2	FC-PSU-UNI2412	SM universal IO PSU 115/230Vac, 24 Vdc, 12 A, UL508
1	FC-PSUTA-0001	SM universal IO PSU shelf
1	10310/1/1CC	Earth leakage detector (rail mounted) CC
2	4600129	Ethernet switch, type EDS-305-S-SC-HPS, make MOXA
1	FC-CCI-HSE-08	SM universal IO ethernet cable set L-0.8m
1	4602956	ESD wristcable
1	4602957	ESD wristlet

Technical data

The RUSFDU-01 unit has the following specifications:

General	Type number:	FC-RUSFDU-01
	Operating temperature:	-5 .. +60 degC (+23 .. +140 degF)
	Storage temperature:	-25 .. +80 degC (-13 .. +176 degF)
	Relative humidity:	5..95% (non condensing)
	Approvals:	CE, UL, TUV
Power IN	Supply voltage:	102..132 Vac or 196 .. 253 Vac
	Supply load:	47 .. 63 Hz
	Supply current:	2 x 0.6A at 120 Vac, 60 Hz (no load) 2 x 1A at 230 Vac, 50 Hz (no load) approx. 35 W (no load)
	PSU efficiency:	> 85%
	Connector:	5 pole header (3 pins used)
	• make and type:	Weidmuller: BLZ 5.08/5F SN SW
	Connector names:	X1, X2

Load Power	Supply voltage:	25 Vdc nominal
	Load current:	0..9 Amp (redundant)
Ethernet switch	Connector CH1..4:	RJ45 (with CAT5PLUS STP cable)
	FO (CH5):	Fiber Optic
Field connectors	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
Physical Data	Cabinet • make and type:	 Rittal: AE 1060.500
	Dimensions (H x W x D):	600 x 600 x 210 mm 23.62 x 23.62 x 8.27 in
	Weight:	39.3 kg (approx.) 86.64 lbs
	Paint:	RAL 7035
	Protection:	NEMA 4, IP 66
	Door:	single (front)
	Gland plate: • make and type:	bottom side; solid gland plate (no holes) Rittal: SZ 2563.100
	Mounting holes:	8.5 mm diameter (at the rear)
	Hole-centre spacing:	560 x 560 mm (rectangular) 22.05 x 22.05 in

RUSFDU-02

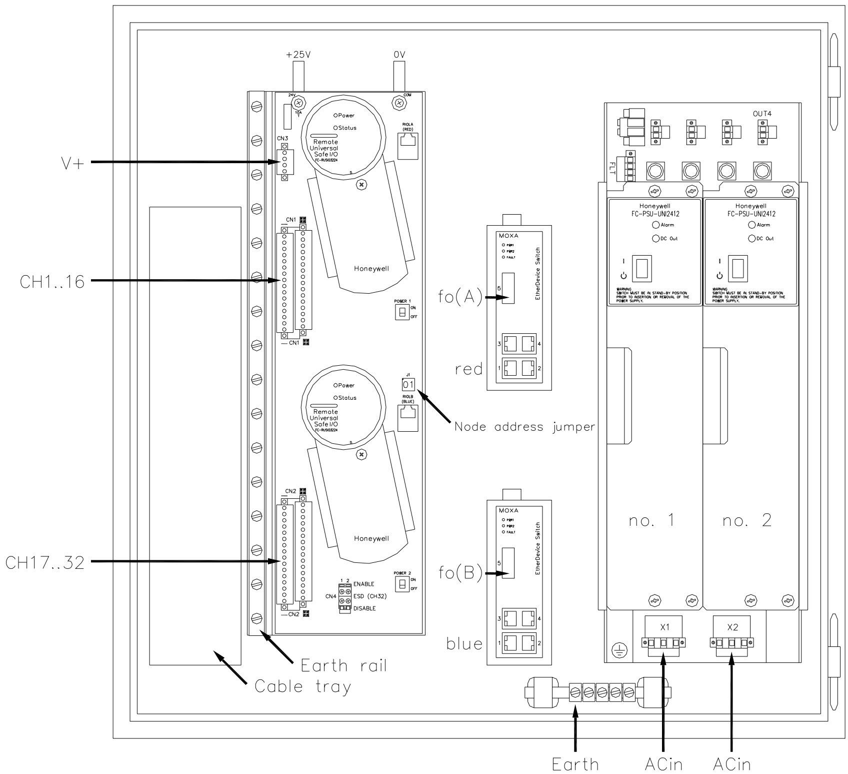
Remote Universal Safe Field Device Unit (type 02)

Description

The RUSFDU-02 is a (600 x 600 x 210 mm) cabinet that can be placed in the field, and is suitable for use at extreme low temperatures. It has 32 universal safe IO channels that are controlled by a SM Controller.
The RUSFDU-02 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

Figure 25 on page 61 shows a (simplified) frontview of the RUSFDU-02 cabinet with the door removed.

Figure 25 Front view

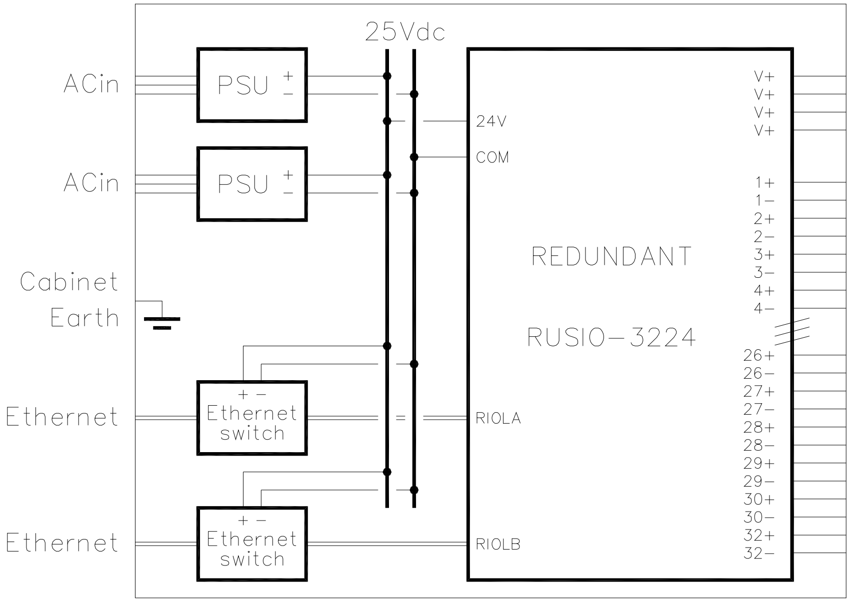


The RUSFDU-02 has the following features:

- It is powered with a (pair of) 120Vac or 230Vac feeder(s).
- It can supply up to 9 Amps of (24Vdc) field load.
- It requires a redundant Ethernet connection of 100 Mbaud to the Safety Manager Controller (dedicated RIO link).

Figure 26 on page 62 shows a simplified block-diagram of the RUSFDU-02.

Figure 26 Block diagram



Universal safe IO channels

The RUSFDU-02 has 32 redundant universal safe IO channels. Channel 31 is used as (common) status input for the PSU, Ethernet switch and ELD status contacts.
The function of other channels can be configured. This is done in Safety Builder.

All channels use the internal 24Vdc supply (without galvanic isolation).

All channels have two connections:

- an (active) plus connection
- a minus connection, directly linked to 0V

Each channel can be configured as:

- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring)
- Analog input (0-20mA or 4-20mA active)
- Analog output (0-20mA or 4-20mA active)

The IOTA-R24 module has two switches (**POWER 1** and **POWER 2**):

- **POWER 1** switches the power for the top RUSIO-3224 module (Module 'A')
- **POWER 2** switches the power for the bottom RUSIO-3224 module (Module 'B')

Each RUSIO-3224 module has two LEDs; one for power indication and one for status indication.

The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

Channel connections

Channel 1 thru 16 on CN1

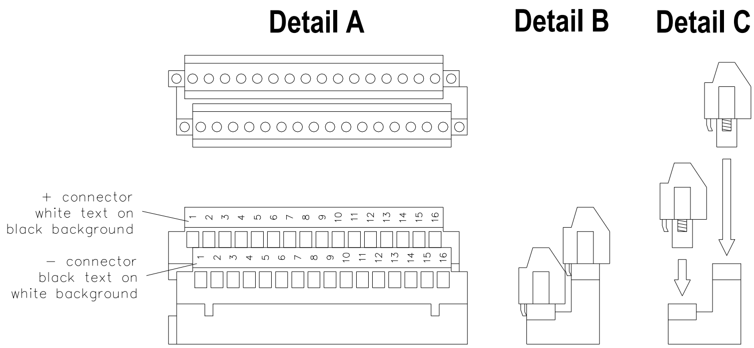
IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 27 Channel 1 thru 16 on CN1



Channel 17 thru 32 on CN2

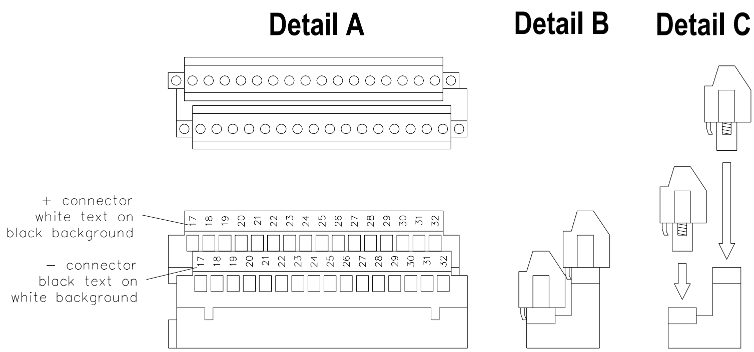
IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 28 Channel 17 thru 32 on CN2



V+ connections on CN3

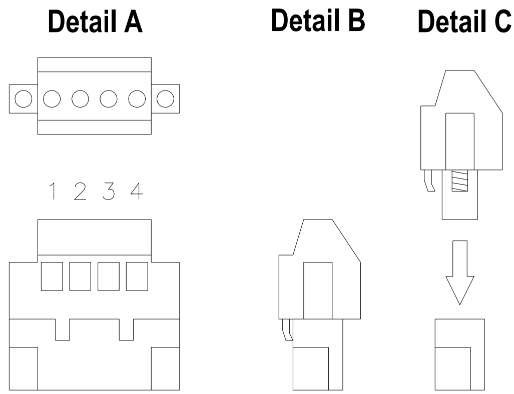
CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

Figure 29 V+ connections on CN3



For further details on the channels, the modules and the mounting assembly, see the datasheets of the RUSIO-3224 module and the IOTA-R24 module.

Earth rail

On the left of CN1 and CN2, there is an earth rail for field cable shield termination.

Redundant 25Vdc power supplies

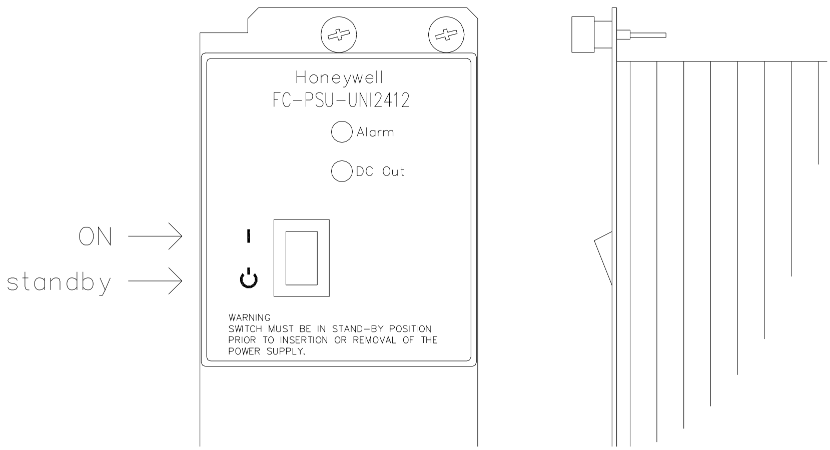
The RUSFDU-02 has two PSU-UNI2412 power supplies.
They can provide 25Vdc, 12 A (out of 120Vac or 230Vac line power).

The PSU-UNI2412 power supply has the following hardware control features:

- An ON/Standby switch
- Two LEDs for status indication,
  one for **Alarm** and one for **DC Out** indications
- Output over voltage protection (OVP)
- An alarm contact (for status)

Figure 30 on page 66 shows a detail of the PSU with the switch and the leds.

Figure 30 PSU-UNI2412 - detailed views



ON/Standby switch

The ON/Standby switch has two positions. The side view on Figure 30 on page 66 shows the stand-by position.

Warning:

The switch must be in stand-by position prior to insertion or removal of the power supply.

PSU Status indications

The **Alarm** LED is:

- Off when the unit is OK or has no power (on AC input)
- Red when the unit is powered (on AC input) but the 25V output is not OK (e.g. because the switch is in the stand-by position)
- Red and blinking when the internal temperature > 90 degC

The **DC Out** LED is:

- green when the 25V output voltage is OK (>22V)
- off when the 25V output voltage is lost

POWER IN connectors

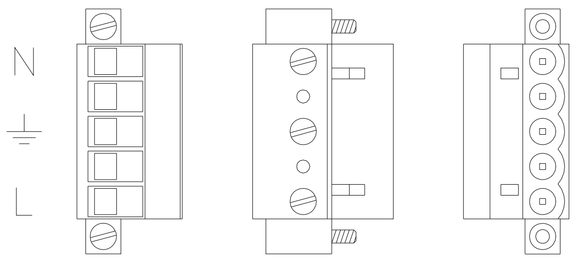
See the figure below for a top, side & bottom view of the POWER IN connectors.

The two (110Vac or 230Vac) POWER IN connectors (**X1** and **X2**) are situated on the lower side of the PCB.

The pin assignment of connectors **X1** and **X2** is:

- pin 5: Neutral (N)
- pin 3: Ground
- pin 1: Line (L)

Figure 31 POWER IN connectors X1 and X2



For further details about the power supplies, see the datasheets of the PSU-UNI2412 module and the PSUTA-0001 module.

Ethernet switch

The (100 Mbaud) MOXA Ethernet switches are of type number:
EDS-305-S-SC-T-HPS-C. They are suitable for use at extreme low temperatures. They have one FO-channel (glass-fiber with SC connector) and four CAT5PLUS STP (shielded twisted pair) channels (with RJ45 connector).
Channel 1 is connected with the local RUSIO-3224 modules.

The top Ethernet switch is connected to the top RUSIO-3224 module (using a cable with red connectors).
The bottom Ethernet switch is connected to the bottom RUSIO-3224 module (using a cable with blue connectors).

The connections to the SM Controller must use the glass-fiber channel (channel 5). The only exception is a RUSFDU-02 that is close to and in the same building as the SM Controller.
Channel 2, 3 and 4 can be used to connect with other RUSFDU-02 units, provided they are nearby and in the same building.

For further details about the MOXA Eternet switch, see the EDS-305 data sheets at www.moxa.com.

Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.
The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.
For an example of a node address jumper see Figure 32 on page 68.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

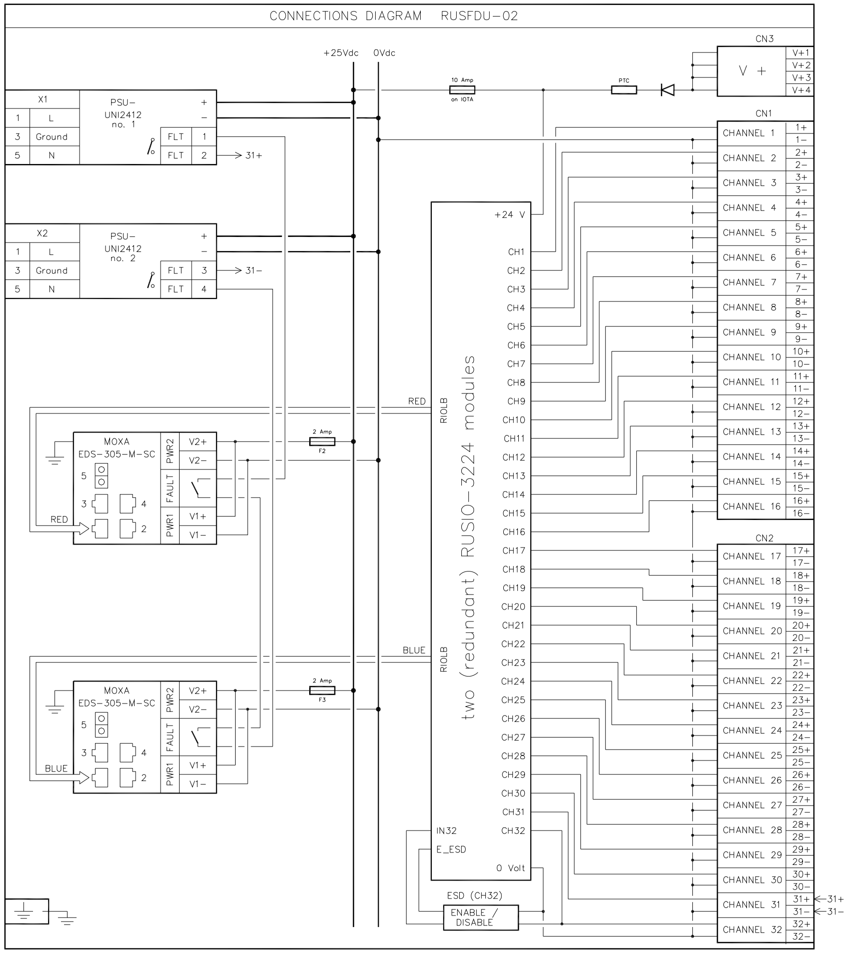
Figure 32 Node address jumper - front and side view

Note: Jumpers are not part of the scope of the RUSFDU-02 cabinet.

Connections

The connection diagram of the RUSFDU-02 is as follows:

Figure 33 Connection diagram



Mounting

Installation

The RUSFDU-02 cabinet can be mounted in one of the following ways:

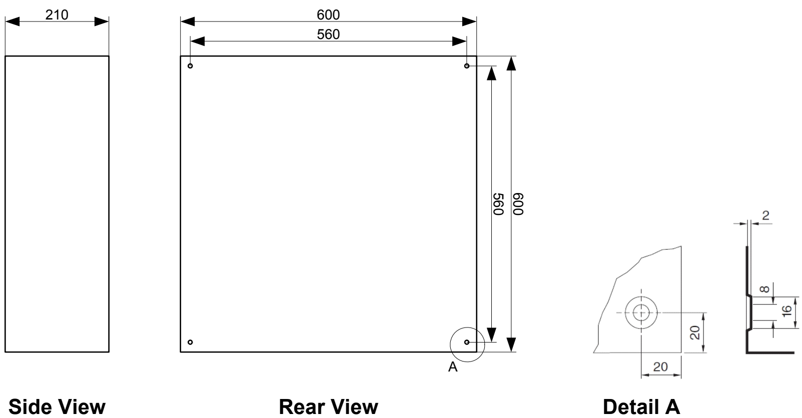
- screwed on a flat surface,
- wall mounted, using wall mounting brackets,
- frame-mounted, using wall mounting brackets; it may be necessary to make adaptions to the existing frame first.

Attention:

The RUSFDU-02 cabinet must be mounted so that the power supply units and SM universal IO modules are in upright position.

Figure 34 on page 70 shows the mechanical dimensions of the cabinet and the coordinates of the (four) mounting holes.

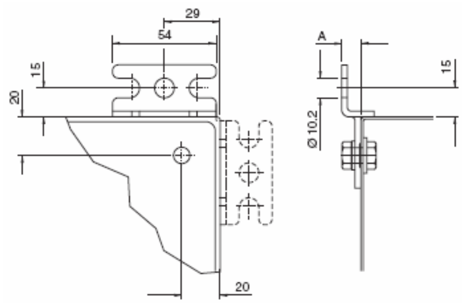
Figure 34 RUSFDU cabinet - dimensions and coordinates [1]



1 dimension are given in millimeters (mm)

Wall mounting brackets are available at manufacturer Rittal (type SZ 2433.500). See Figure 35 on page 71 for a detailed view.

Figure 35 Wall mounting bracket - detailed view [1]



1 dimension are given in millimeters (mm)

Note: Brackets are not part of the scope of the RUSFDU-02 cabinet.

Cable management

The RUSFDU-02 cabinet is made of stainless steel and has no gland plate. During installation holes must be drilled for the cable glands that are applied.

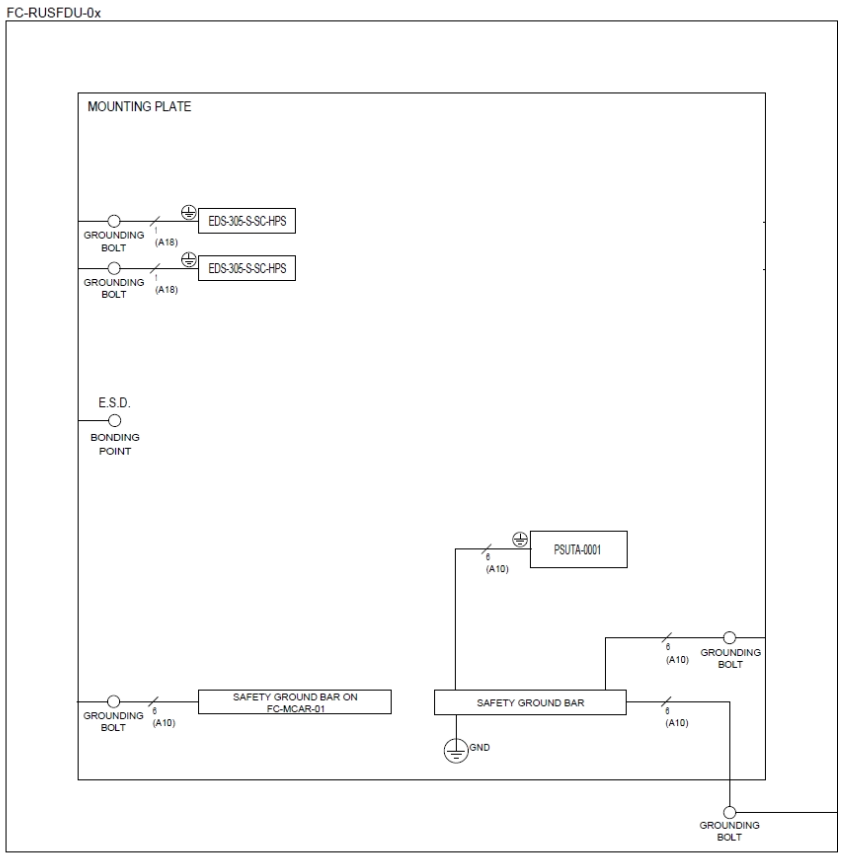
In order to maintain suitability for operation at extreme low temperatures, make sure that you:

- use correct types of cable glands,
- apply cable glands correctly.

Earthing

Figure 36 on page 72 shows the earthing arrangement of the RUSFDU-02 cabinet.

Figure 36 RUSFDU cabinet - earthing arrangement



Note: the door is connected to the safety ground bar, using a 6 mm^2 (A10) ground strap.

Bill of materials

Table 4 on page 73 gives an overview of those parts of the RUSFDU-02 cabinet that can be ordered separately for spare parts, if required.

Table 4 RUSFDU-02 - spare parts list

Quantity	Order number	Description
2	FC-RUSIO-3224	SM universal IO module, 32 channels, 24 Vdc
1	FC-IOTA-R24	SM universal IO redundant IO termination assembly
1	FC-MCAR-01	SM universal IO 18 inch carrier
2	FC-PSU-UNI2412	SM universal IO PSU 115/230Vac, 24 Vdc, 12 A, UL508
1	FC-PSUTA-0001	SM universal IO PSU shelf
2	4600135	Ethernet switch, type EDS-305-S-SC-T-HPS-C, make MOXA
1	FC-CCI-HSE-08	SM universal IO ethernet cable set L-0.8m
1	4602956	ESD wristcable
1	4602957	ESD wristlet

Technical data

The RUSFDU-02 unit has the following specifications:

General	Type number:	FC-RUSFDU-02
	Operating temperature:	–40°C ... +70°C (–40°F ... +158°F)
	Storage temperature:	–40°C ... +85°C (–40°F ... +185°F)
	Relative humidity:	5..95% (non condensing)
	Approvals:	CE, UL, TUV
Power IN	Supply voltage:	102..132 Vac or 196 .. 253 Vac
	Supply load:	47 .. 63 Hz
	Supply current:	2 x 0.6A at 120 Vac, 60 Hz (no load) 2 x 1A at 230 Vac, 50 Hz (no load) approx. 35 W (no load)
	PSU efficiency:	> 85%
	Connector:	5 pole header (3 pins used)
	• make and type:	Weidmuller: BLZ 5.08/5F SN SW
	Connector names:	X1, X2

Load Power	Supply voltage:	25 Vdc nominal
	Load current:	0..9 Amp (redundant)
Ethernet switch	Connector CH1..4:	RJ45 (with CAT5PLUS STP cable)
	FO (CH5):	Fiber Optic
Field connectors	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
Physical Data	Cabinet • make and type:	 Rittal: AE 1010.500
	Dimensions (H x W x D):	600 x 600 x 210 mm 23.62 x 23.62 x 8.27 in
	Weight:	40.0 kg (approx.) 88.18 lbs
	Material: • finish:	Stainless steel, ASI 316 L Brushed, grain size 240
	Protection:	NEMA 12, NEMA 4x, IP 66
	Door:	single (front)
	Gland plate:	none
	Mounting holes:	8.5 mm diameter (at the rear)
	Hole-centre spacing:	560 x 560 mm (rectangular) 22.05 x 22.05 in

MCAR-01

Mounting Carrier (18 inch)

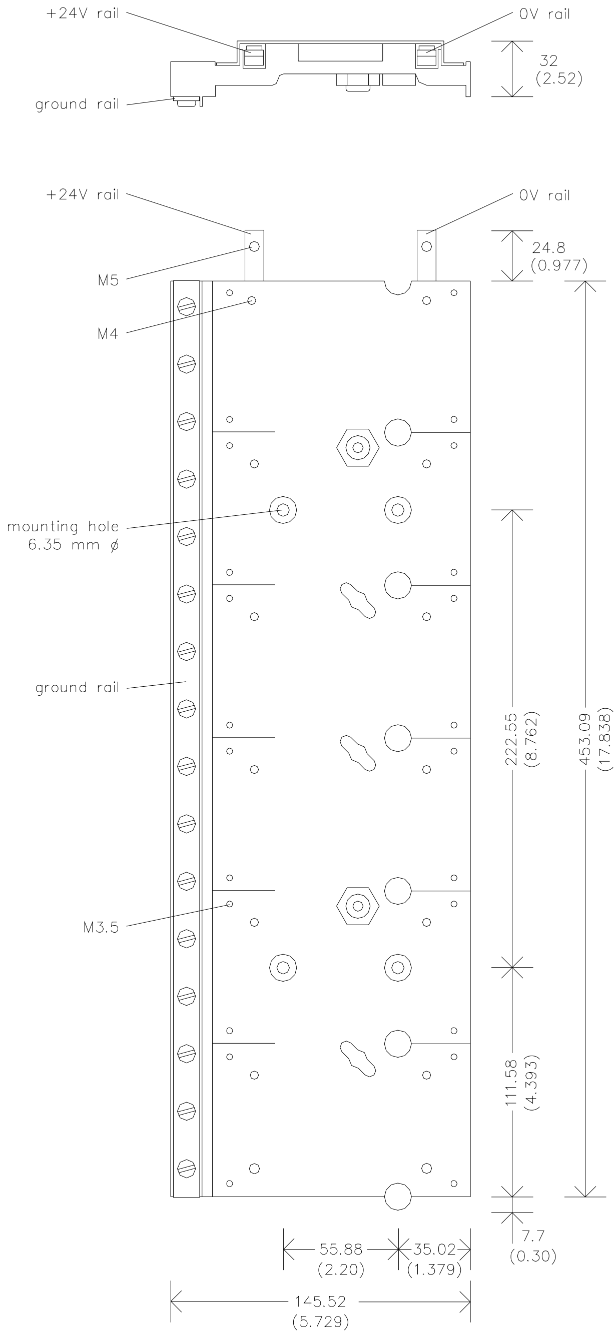
Description

The MCAR-01 is a carrier that can be screwed on any flat surface.
The MCAR-01 can carry one IOTA-R24 assembly. Figure 37 on page 76 shows the physical appearance and the coordinates of the four mounting holes.

The MCAR-01 consists of:

- a metal profile
- a plastic cover plate
- a ground rail with 16 ground connection screws
- two power rails with M5 holes (+24V and 0V)
- four mounting holes (6.35 mm diameter)

Figure 37 Mechanical layout

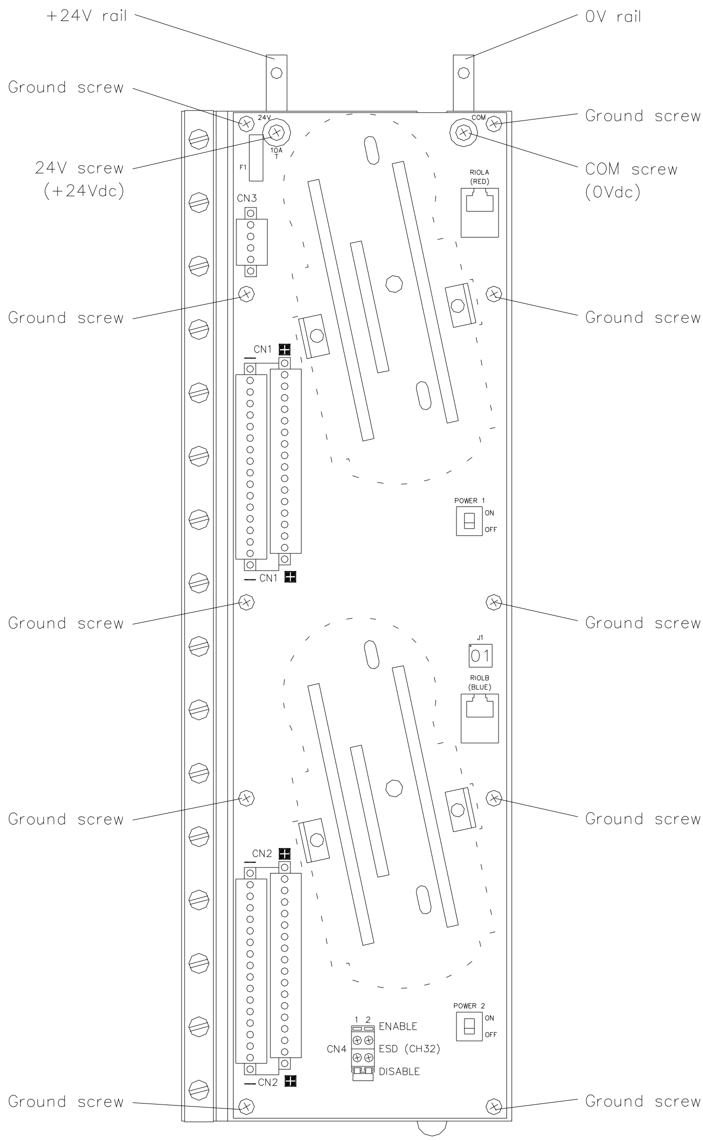


Mounting an IOTA-R24

The IOTA-R24 is fixed on the MCAR-01 with ten ground screws and two power screws (24V and COM).

24Vdc power must be connected to the MCAR-01 on the power rails using M5 screws.

Figure 38 MCAR-01 with a mounted IOTA-R24

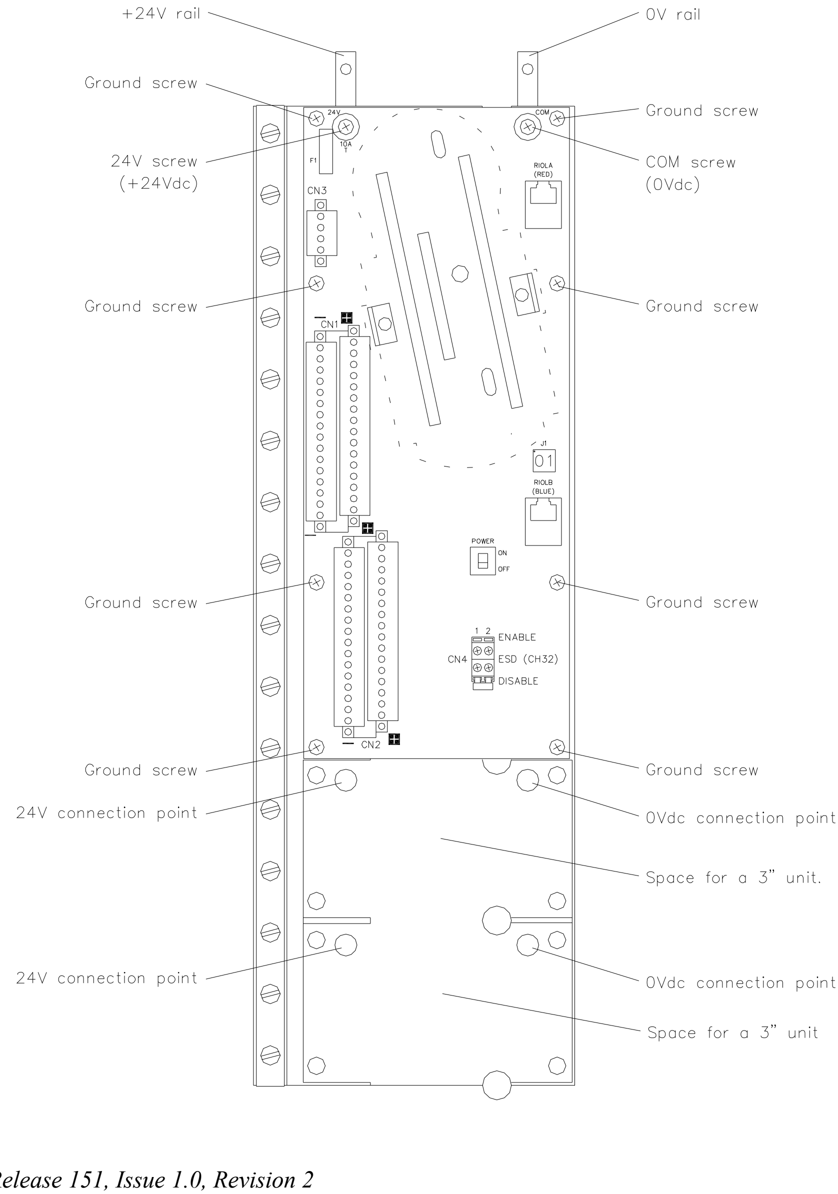


Mounting an IOTA-NR24

The IOTA-NR24 is fixed on the MCAR-01 with eight ground screws and two power screws (24V and COM).
This leaves room on the MCAR-01 for two 3 inch units or one 6 inch unit.

24Vdc power must be connected to the MCAR-01 on the power rails using M5 screws.

Figure 39 MCAR-01 with a mounted IOTA-NR24



Technical data

The MCAR-01 has the following specifications:

General	Type number:	FC-MCAR-01
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL pending
Power	Supply voltage:	24 Vdc -15%..+30%
	Supply current:	none
	Supply rail current:	max. 40 A
Connections	24V supply:	2 x M5
	Ground:	16 x M5
Physical Data	Dimensions (H x W x D):	32 x 145.6 x 478 mm 2.52 x 5.73 x 18.8 in
	Weight:	1.1 kg 2.4 lbs

MCAR-02

Mounting Carrier (36 inch)

Description

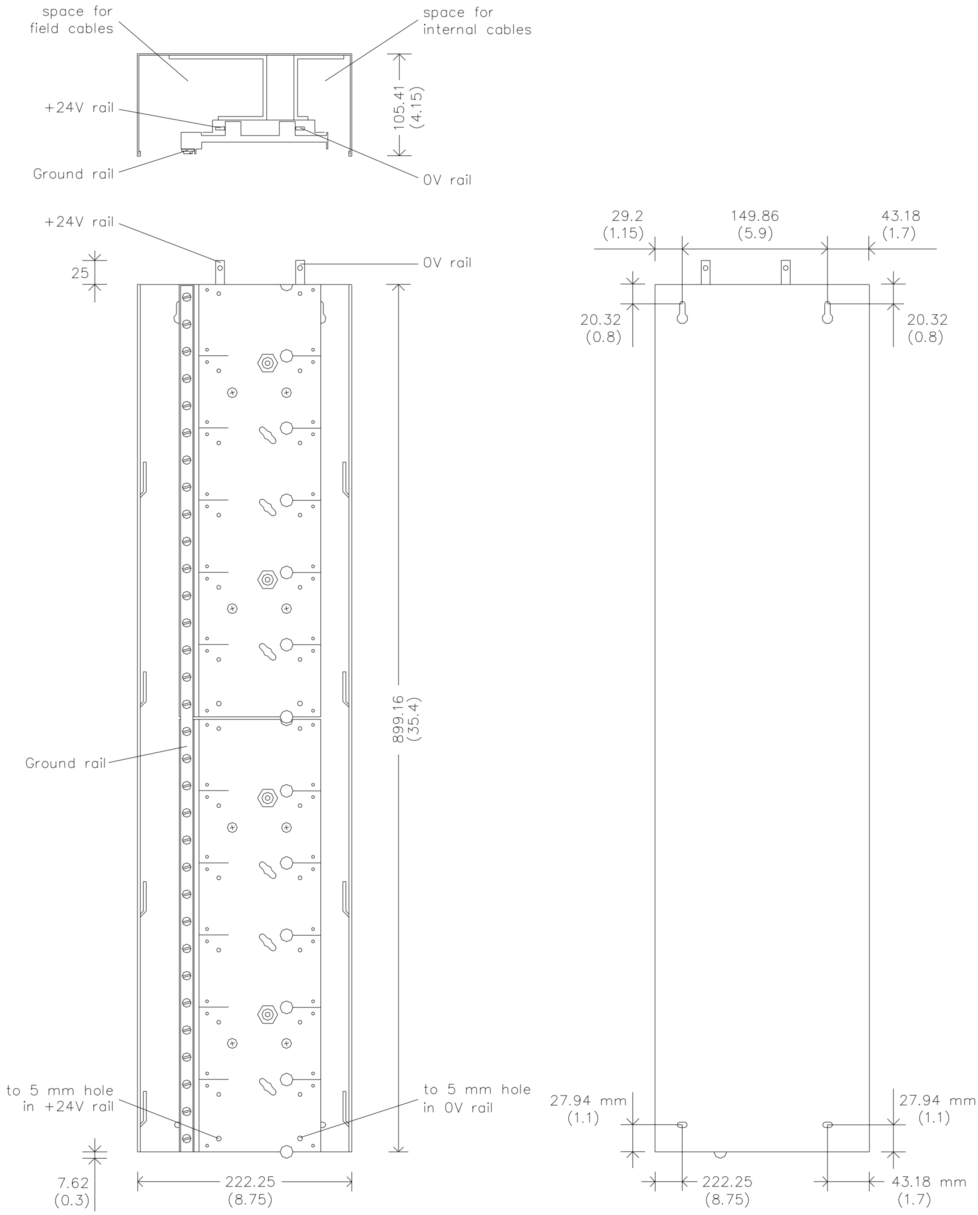
The MCAR-02 is a carrier that can be screwed on any flat surface.
The MCAR-02 can carry two IOTA-R24 assemblies. Figure 40 on page 81 shows the physical appearance and the coordinates of the four mounting holes.

The MCAR-02 consists of:

- a Cable Carrier Assembly (CCA)
- a metal profile
- two plastic cover plates
- a ground rail with 32 ground connection screws
- two power rails with M5 holes (+24V and 0V)
- four mounting holes (use screws with a diameter <5.5 mm)

The power rails of two MCAR-02 carriers can be coupled. Use two M5 screws to connect the two power rials of the top carrier with the bottom carrier (through the 5 mm holes).

Figure 40 MCAR-02 - top, front and rear views

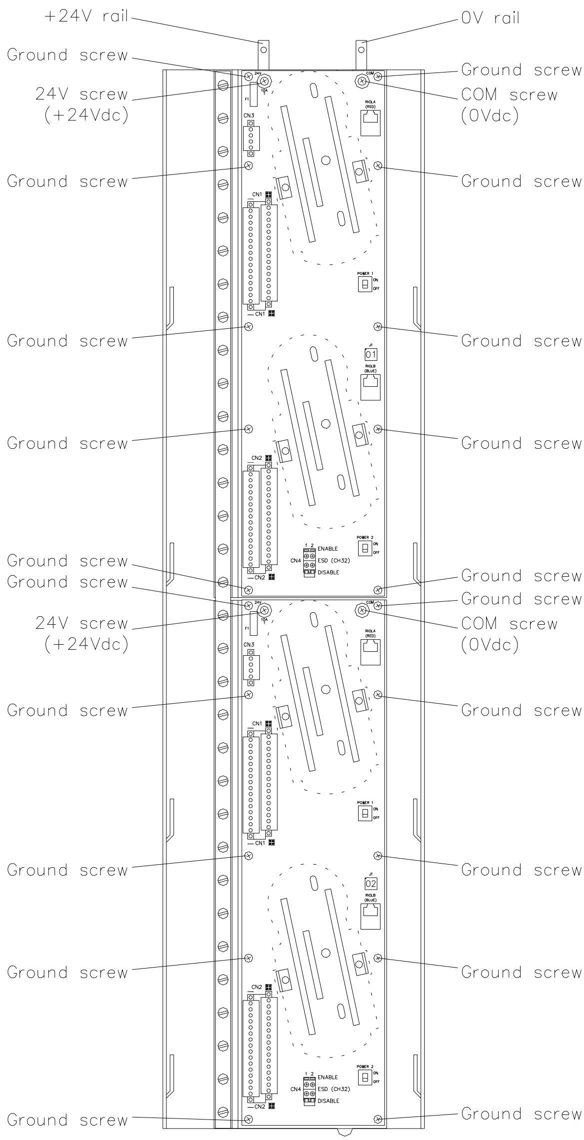


Mounting an IOTA-R24

An IOTA-R24 is fixed on the MCAR-02 with ten ground screws and two power screws (24V and COM).

24Vdc power must be connected to the MCAR-02 on the power rails using M5 screws.

Figure 41 MCAR-02 with two mounted IOTA-R24 modules

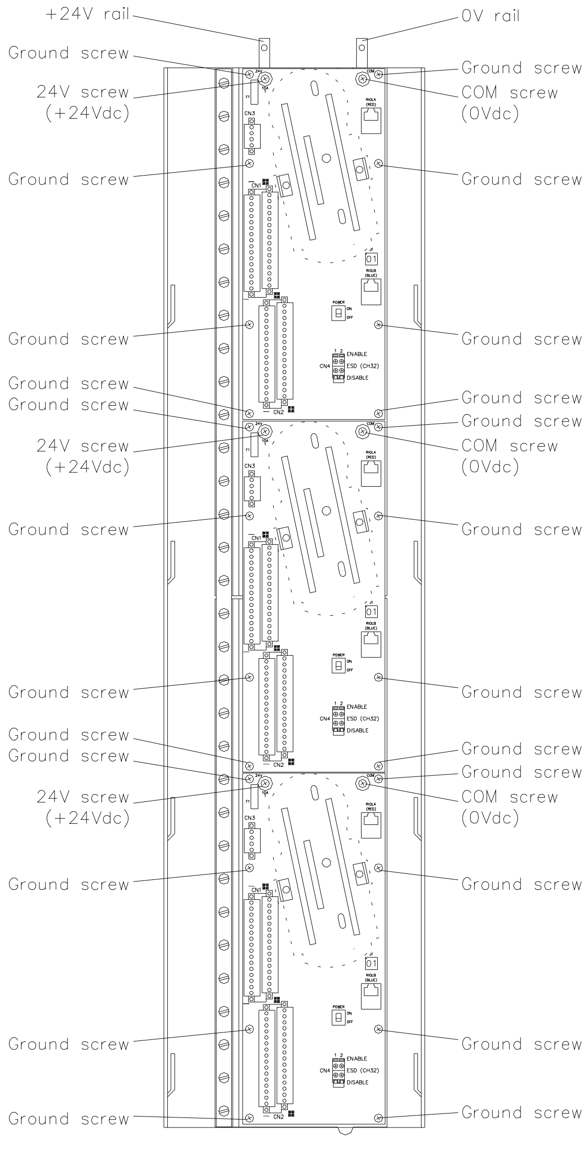


Mounting IOTA-NR24 units

Up to three (3) IOTA-NR24 units can be fixed on the MCAR-02 with eight ground screws and two power screws (24V and COM) each.

24Vdc power must be connected to the MCAR-02 on the power rails using M5 screws.

Figure 42 MCAR-02 with two mounted IOTA-NR24 modules



Technical data

The MCAR-02 has the following specifications:

General	Type number:	FC-MCAR-02
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL pending
Power	Supply voltage:	24 Vdc -15%..+30%
	Supply current:	none
	Supply rail current:	max. 40 A
Connections	24V supply:	2 x M5 2 x 5mm hole (for coupling of carriers)
	Ground:	32 x M5
Physical Data	Dimensions (H x W x D):	105.4 x 222.3 x 931.8 mm 4.15 x 8.75 x 36.7 in
	Weight:	6.1 kg 13.4 lbs

Chassis

5

This chapter describes the following chassis:

Chassis		See
General info about chassis		page 86
Safety Manager		
CPCHAS-0001	Chassis for redundant or non-redundant Controller (Safety Manager)	page 87
IOCHAS-0001S	IO Chassis for non-redundant IO modules (Safety Manager)	page 98
IOCHAS-0001R	IO chassis for redundant IO modules (Safety Manager)	page 107
Safety Manager A.R.T.		
CPCHAS-0002	Chassis for redundant Controller (Safety Manager A.R.T.)	page 116
IOCHAS-0002S	IO Chassis for non-redundant IO modules (Safety Manager A.R.T.)	page 126
IOCHAS-0002R	IO chassis for redundant IO modules (Safety Manager A.R.T.)	page 135

General info about chassis

Safety Manager is installed in a cabinet, as described in “Cabinet” on page 33. A cabinet contains the Control Processor modules and the IO modules, which are placed in several chassis:

- All Control Processor modules are placed in a Control Processor chassis.
- All non-redundant IO modules are placed in one or more IOCHAS-0001S or IOCHAS-0002S chassis.
- All redundant IO modules are placed in one or more IOCHAS-0001R or IOCHAS-0002R chassis.

A chassis consists of a metal housing, in which the modules, busses and backplanes are placed. The details are described separately for each type of chassis in this chapter.

The housing of a Controller chassis differs from the housing of an IO chassis.

CPCHAS-0001

Chassis for redundant or non-redundant Controller (Safety Manager)

General

The Controller chassis CPCHAS-0001 is used to contain the Control Processor modules. Each Safety Manager has one Controller chassis. The Controller chassis is generally located at the top position in the cabinet, and the IO chassis at lower positions.

A Controller chassis contains the following components:

- Controller housing (see “Controller housing” on page 87)
- Controller backplane CPB-0001 (see “Controller backplane CPB-0001” on page 91)

Controller housing

The Controller housing has been designed specifically for Safety Manager. It is a 19" housing that is open at the front and covered at the back.

Control Processor modules are placed in the chassis through the front of the housing with the use of module guides, which are located at the bottom and top plate of the housing.

The modules are locked in the chassis with the quarter turn fasteners, located below the module-grips.

Figure 43 on page 87 shows the front of a filled redundant Controller chassis.

Figure 43 Front view of a redundant Controller chassis

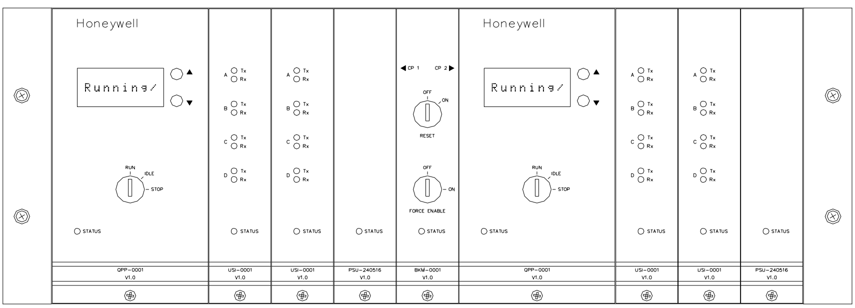
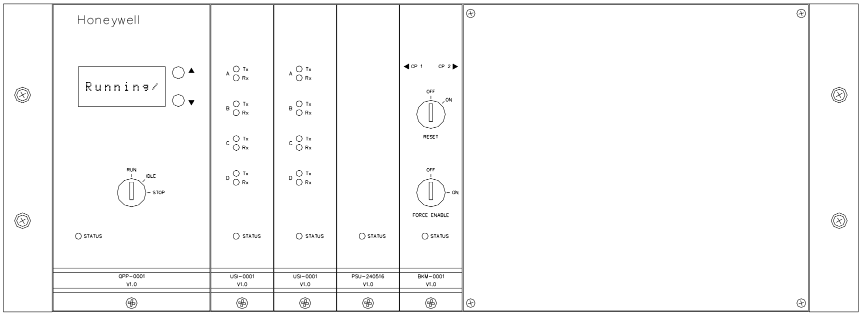


Figure 44 on page 88 shows the front of a filled non-redundant Controller chassis.

Figure 44 Front view of a non-redundant Controller chassis

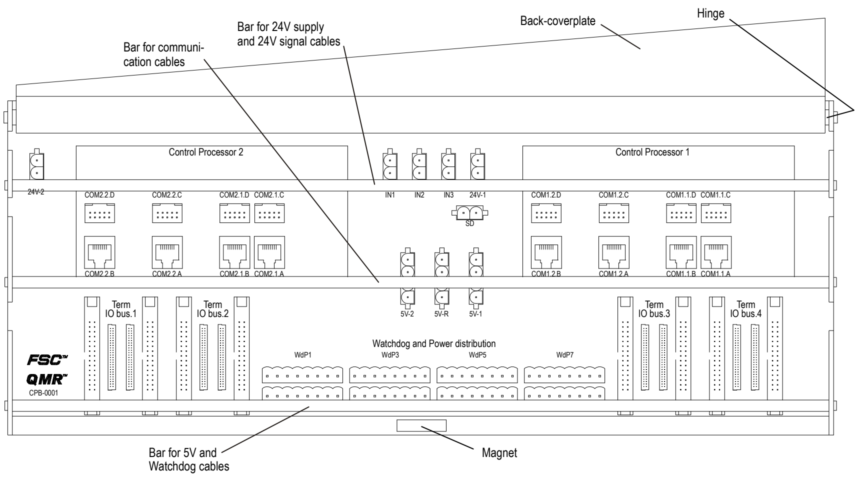


The back of the housing is covered by a magnetically locked back cover plate, which can be swung upwards to reveal the Controller backplane.

Cables must be tie-wrapped to one of the three horizontal bars at the back of the housing, to lead them towards the side of the chassis.
The top bar is reserved for the 24V-supply and 24V-signal wires/cables.
The middle bar is reserved for the communication cables.
The bottom bar is reserved for the 5V and Watchdog cables (WdPx and 5V-x).

Figure 45 on page 88 shows the back of an empty Controller chassis.

Figure 45 Back view of an empty Controller chassis



Location of Control Processor modules

The Controller chassis CPCHAS-0001 contains all Control Processor modules.

Table 5 on page 89 shows the location of the Control Processor modules in a non-redundant and a redundant Controller (as seen from the front of the cabinet). As you can see, all Control Processor modules are doubled in a redundant Controller configuration, with the exception of the Battery and Key switch module, which is shared by both Control Processors.

Table 5 Distribution of the various Control Processor modules in the Controller chassis

<table>
<tr><th colspan="9">Redundant Controller</th></tr>
<tr><th colspan="5">Non-Redundant Controller</th><th colspan="4"></th></tr>
<tr><td>C
P
U
1</td><td>C
O
M
1 .1</td><td>C
O
M
1 .2</td><td>P
S
U
1</td><td>B
K
M</td><td>C
P
U
2</td><td>C
O
M
2 .1</td><td>C
O
M
2 . 2</td><td>P
S
U
2</td></tr>
<tr><th colspan="9">Legend:</th></tr>
<tr><th>Item</th><th colspan="6">Description</th><th colspan="2">See</th></tr>
<tr><td>CPU1</td><td colspan="8">the processor module of the first Control Processor</td></tr>
<tr><td></td><td colspan="6">QPP-0001 Quad Processor Pack</td><td colspan="2">page 240</td></tr>
<tr><td></td><td colspan="6">QPP-0002 Quad Processor Pack</td><td colspan="2">page 253</td></tr>
<tr><td rowspan="4">COM1.1</td><td colspan="8">the first communication module of the first Control Processor</td></tr>
<tr><td colspan="6">USI-0001 Universal Safety Interface, or</td><td colspan="2">page 266</td></tr>
<tr><td colspan="6">USI-0002 Universal Safety Interface, or</td><td colspan="2">page 271</td></tr>
<tr><td colspan="6">BLIND-COM Dummy Communication Module</td><td colspan="2">page 275</td></tr>
<tr><td rowspan="4">COM1.2</td><td colspan="8">the second communication module of the first Control Processor</td></tr>
<tr><td colspan="6">USI-0001 Universal Safety Interface, or</td><td colspan="2">page 266</td></tr>
<tr><td colspan="6">USI-0002 Universal Safety Interface, or</td><td colspan="2">page 271</td></tr>
<tr><td colspan="6">BLIND-COM Dummy Communication Module</td><td colspan="2">page 275</td></tr>
<tr><td rowspan="2">PSU1</td><td colspan="8">the power supply module of the first Control Processor</td></tr>
<tr><td colspan="6">PSU-240516 Power Supply Unit 24/5 Vdc, 16A</td><td colspan="2">page 284</td></tr>
<tr><td rowspan="2">BKM</td><td colspan="8">the battery and key switch module of (both) Control Processor(s)</td></tr>
<tr><td colspan="6">BKM-0001 Battery and Key switch Module</td><td colspan="2">page 277</td></tr>
<tr><td rowspan="3">CPU2</td><td colspan="8">the processor module of the first Control Processor</td></tr>
<tr><td colspan="6">QPP-0001 Quad Processor Pack</td><td colspan="2">page 240</td></tr>
<tr><td colspan="6">QPP-0002 Quad Processor Pack</td><td colspan="2">page 253</td></tr>
</table>

Table 5 Distribution of the various Control Processor modules in the Controller chassis *(continued)*

Redundant Controller		
Non-Redundant Controller		
COM2.1	the first communication module of the second Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275
COM2.2	the second communication module of the second Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275
PSU2	the power supply module of the second Control Processor	
	PSU-240516 Power Supply Unit 24/5 Vdc, 16A	page 284

In case of a non-redundant Controller, the unused positions in the Controller chassis (CPU2, COM2.1, COM2.2, and PSU2 are covered by an BLIND-CPS plate (see Figure 44 on page 88).

For each Quad Processor Pack, room is provided for two communication modules in the Controller chassis. Table 6 on page 90 shows possible locations for different combinations of communication modules.

Note

If only one communication module is used in a Control Processor, the module is placed in the COM1 slot (see Table 6 on page 90). A blind communication module (BLIND-COM) should be placed in all unused communication slots.

Table 6 Possible locations of communication modules in the Controller chassis

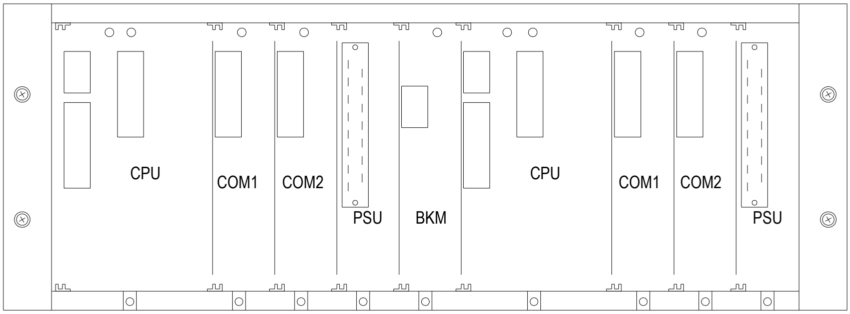
Number of modules	COM1 Slot	COM2 Slot
0	BLIND-COM	BLIND-COM
1	USI-0001 or USI-0002	BLIND-COM
2	USI-0001 or USI-0002	USI-0001 or USI-0002

Controller backplane CPB-0001

The Controller backplane is part of the Controller chassis. The front side contains the connectors for the Control Processor modules. The keying pins in the backplane connect the module housings with ground.

Figure 46 on page 91 shows the front view of an empty redundant Controller chassis, showing the Controller backplane.

Figure 46 Front view of an empty redundant Controller chassis



The back side of the Controller backplane contains all the connectors for signals that go in or out of the (non-)redundant Controller. These connectors are visible when the back cover plate is swung upwards (see Figure 45 on page 88).

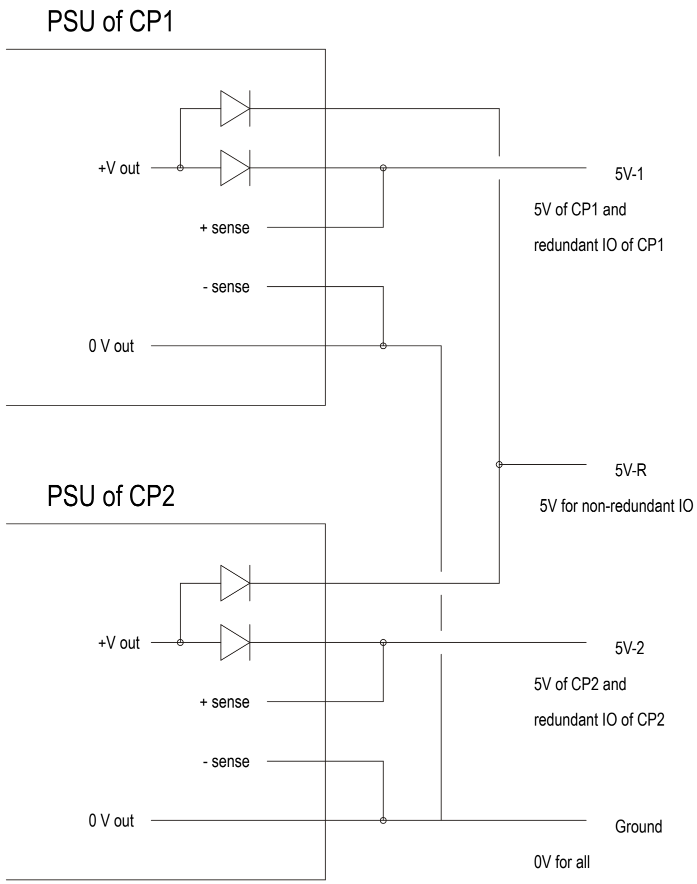
The Controller backplane connects the 5VR output of the PSU of CP1 with the 5VR output of the PSU of CP2.

The resulting 5V-R is used to supply the non-redundant IO.

Thanks to the output diodes in the PSU-240516 (see Figure 168 on page 286) the 5V-R will be available as long as (at least) one of the PSUs is operating.

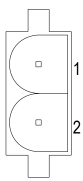
Figure 47 on page 92 shows the 5V connection of the two PSU-240516 modules on the Controller backplane.

Figure 47 5V PSU-connection on the CP backplane

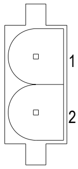


Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:

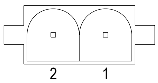
		24V-1	**24V-2**
	1	+24V for CP1	+24V for CP2
	2	0V for CP1	0V for CP2

The back view and pin allocation of the IN1, IN2 and IN3 connectors are:



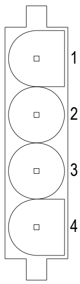
	IN1	IN2	IN3
1	+24V_red	+24V_red	+24V_red
2	input1	input2	input3

The back view and pin allocation of the SD connector is:



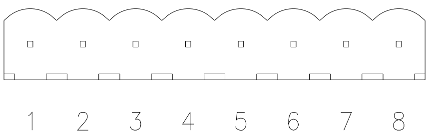
	SD
1	+24V_sd
2	input

The back view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	5V-R	5V-1
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

The back view and pin allocation of the eight WdPx connectors are:



	WdPx
1	5V of CP2
2	WD of CP2
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	5V of CP1
8	WD of CP1

Connector function

Table 7 on page 94 describes the function of the connectors on the back side of the Controller backplane.

Table 7 Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 1	Com1.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com1.1.B	RJ45	
	Com1.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com1.1.D	10-pin male	
	Com1.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com1.2.B	RJ45	
	Com1.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com1.2.D	10-pin male	
Control Processor 2	Com2.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com2.1.B	RJ45	
	Com2.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com2.1.D	10-pin male	
	Com2.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com2.2.B	RJ45	
	Com2.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com2.2.D	10-pin male	
IO bus 1	IO bus1.1	Flat cable connector	first IO bus of Control Processor 1
	IO bus2.1	Flat cable connector	first IO bus of Control Processor 2
	Term IO bus1	2 × 50-pin connector	IO bus terminator for the first IO bus(es) Type: TERM-0001 or TERM-0002, see page 485 for details.
IO bus 2	IO bus1.2	Flat cable connector	second IO bus of Control Processor 1
	IO bus2.2	Flat cable connector	second IO bus of Control Processor 2
	Term IO bus2	2 × 50-pin connector	IO bus terminator for the second IO bus(es) Type: TERM-0001 or TERM-0002, see page 485 for details.

Table 7 Connectors at the back side of the Controller backplane *(continued)*

Group	Name	Connector type	Used for
IO bus 3	IO bus1.3	Flat cable connector	third IO bus of Control Processor 1
	IO bus2.3	Flat cable connector	third IO bus of Control Processor 2
	Term IO bus3	2 × 50-pin connector	IO bus terminator for the third IO bus(es) Type: TERM-0001 or TERM-0002, see page 485 for details.
IO bus 4	IO bus1.4	Flat cable connector	fourth IO bus of Control Processor 1
	IO bus2.4	Flat cable connector	fourth IO bus of Control Processor 2
	Term IO bus4	2 × 50-pin connector	IO bus terminator for the fourth IO bus(es) Type: TERM-0001 or TERM-0002, see page 485 for details.
Watchdog and Power[1] distribution	WdP1	8-pin male connector	Watchdog and Power to IO chassis 1[2]
	WdP2	8-pin male connector	Watchdog and Power to IO chassis 2
	WdP3	8-pin male connector	Watchdog and Power to IO chassis 3
	WdP4	8-pin male connector	Watchdog and Power to IO chassis 4
	WdP5	8-pin male connector	Watchdog and Power to IO chassis 5
	WdP6	8-pin male connector	Watchdog and Power to IO chassis 6
	WdP7	8-pin male connector	Watchdog and Power to IO chassis 7
	WdP8	8-pin male connector	Watchdog and Power to IO chassis 8

Table 7 Connectors at the back side of the Controller backplane *(continued)*

Group	Name	Connector type	Used for
Power	24V-1	2-pin male connector	24V for Control Processor 1 (for cable details see “PDC-CP24” on page 807).
	24V-2	2-pin male connector	24V for Control Processor 2 (for cable details see “PDC-CP24” on page 807).
	5V-1	4-pin male connector	5V and Watchdog of Control Processor 1. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see “PDB-IOX05” on page 830).
	5V-2	4-pin male connector	5V and Watchdog of Control Processor 2. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see “PDB-IOX05” on page 830).
	5V-R	4-pin male connector	Redundant 5V and redundant Watchdog. This connector is used to distribute these signals to other (extension) cabinets using an PDB-IOX05 (for more information see “PDB-IOX05” on page 830).
Various	SD	2-pin male connector	Connector for an Emergency Shut Down system. The chassis is delivered with the LINK-SD link placed. This link is required if the Emergency Shut Down function is not used (see also QPP data sheets “QPP-0001” on page 240 and “QPP-0002” on page 253 and “SICP-0002/L3” on page 722).
	IN1	2-pin male connector	24 Volt non-safety related general purpose input. This input can generate an interrupt (on the rising edge) e.g. for external clock synchronization (see also “BKM-0001” on page 277 and “SICP-0002/L3” on page 722).
	IN2	2-pin male connector	24 Volt non-safety related general purpose input (see also “BKM-0001” on page 277 and “SICP-0002/L3” on page 722).
	IN3	2-pin male connector	24 Volt non-safety related general purpose input (see also “BKM-0001” on page 277 and “SICP-0002/L3” on page 722).

1 Watchdog and 5 Volt of Control Processor 1, Control Processor 2 and the redundant Watchdog and 5 Volt.

2 The chassis numbers mentioned here are defined by jumpers on the IO backplane

Technical data

General	Type number[1]:	FS-CPCHAS-0001 V1.1
	Approvals:	CE, UL, CSA, TUV, FM
Power	5V-1:	0.05 A
	5V-2:	0.05 A
Dimensions	Height:	4 HE (177 mm, 7 in)
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	5.8 kg, 12.8 lb

1 Chassis with suffix code V1.1 and higher have an improved cover plate design and reduced power consumption. (Chassis with suffix code V1.0 consume 0.5A per feeder.)
There are no functional changes.

IOCHAS-0001S

IO Chassis for non-redundant IO modules (Safety Manager)

Description

The IOCHAS-0001S is a chassis for up to 18 non-redundant IO modules. It consists of the following components:

Table 8 Components of the FS-IOCHAS-0001S[1] V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 99
FS-IOB-0001S[1]	1	IO Backplane for non-redundant IO	page 100
FS-IO-0001[1] V1.0	1	IO Extender module located at slot 21	page 479
FS-IOBUS-HBS[1] V1.0	1	Horizontal IO bus backplane for non-redundant IO	page 104
Blind fronts	2	Located at slot 19 and 20	

1 FS-type modules are non conformal coated modules.

Table 9 Components of the FC-IOCHAS-0001S[1] CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 99
FS-IOB-0001S	1	IO Backplane for non-redundant IO	page 100
FC-IO-0001[1] CCV1.0	1	IO Extender module located at slot 21	page 479
FC-IOBUS-HBS[1] CCV1.0	1	Horizontal IO bus backplane for non-redundant IO	page 104
Blind fronts	2	Located at slot 19 and 20	

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters ‘CC’ preceding the version number.

Figure 48 Front view of an empty IOCHAS-0001S

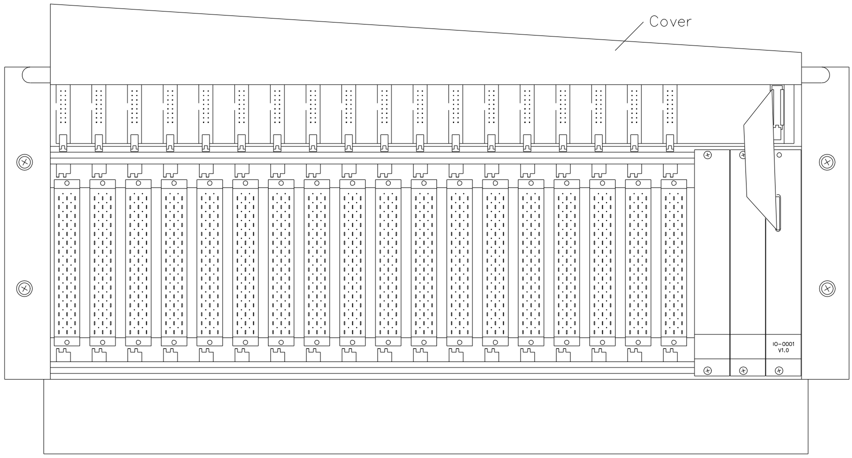


Figure 48 on page 99 shows the front side of an empty IOCHAS-0001S with the front-cover raised. A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis.
In the IOCHAS-0001S, slots 1 to 18 are available for IO modules.
Slot 19 and 20 cannot be used and slot 21 contains the IO-0001 module.
The IOB-0001S provides the 18 IO-connectors in the middle of the chassis.
The IOBUS-HBS provides the 18 flatcable-connectors in the top of the chassis.

IO Housing

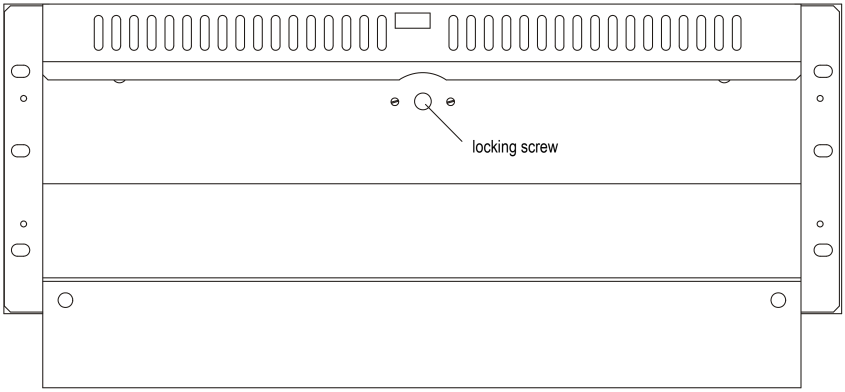
The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A coverplate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tagnumber assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see Figure 49 on page 100).

Figure 49 Back view of a closed IOCHAS-0001S



Attention

The IO back cover plate will be completely unattached from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

Figure 54 on page 106 shows a side view of the IOCHAS-0001S.

IO Backplane for non-redundant IO: IOB-0001S

The front of the IOB-0001S backplane is visible in the middle of Figure 48 on page 99.

Figure 50 on page 101 shows the back of the IOCHAS-0001S with the back-cover removed.

Table 10 on page 101 describes the connectors present on the IOB-0001S.

Figure 50 Back view of an open IOCHAS-0001S

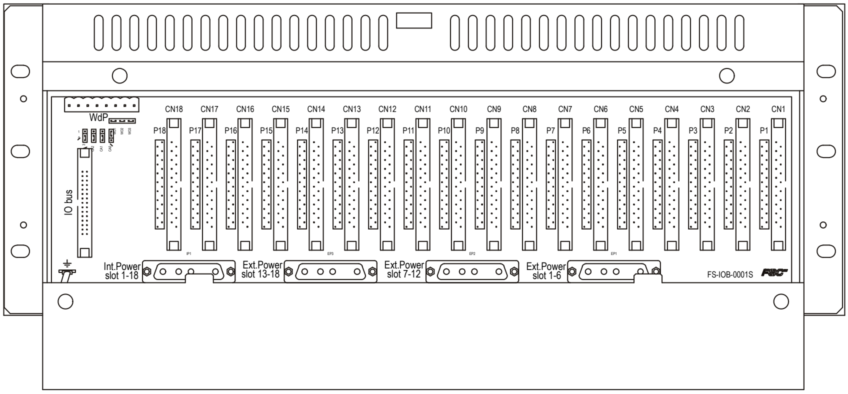


Table 10 Connectors on the IOB-0001S

Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	Connectors for IO modules, slot 1 to 18	"Input modules" on page 289 "Output modules" on page 343
48-pin female chassis connector	1	Connector for IO extender IO-0001, slot 21	"IO-0001" on page 479
Back side			
IO bus	1	Connector for IOBUS-CPIO (IO bus to Controller chassis)	"IOBUS-CPIO" on page 491
CN1 to CN18	18	Connector for system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1 to 18	"SICC-0001/Lx" on page 715 "SICP-0001/Lx" on page 718
P1 to P18	18	Connector for IO converter modules, slot 1 to 18	"Input converter modules" on page 321 "Output converter modules" on page 407
IP1	1	Connector for internal power, slot 1 to 18	Cable: FS-PDC-IOIP1, see "PDC-IOxPx" on page 809

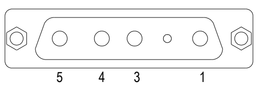
Table 10 Connectors on the IOB-0001S *(continued)*

Connector	Amount	Description	See
EP1	1	Connector for external power, slot 1 to 6	Cable: FS-PDC-IOEP1, see “PDC-IOxPx” on page 809
EP2	1	Connector for external power, slot 7 to 12	Cable: FS-PDC-IOEP2, see “PDC-IOxPx” on page 809
EP3	1	Connector for external power, slot 13 to 18	Cable: FS-PDC-IOEP3, see “PDC-IOxPx” on page 809
CA0 to CA3	4	Jumpers for defining the IO chassis address	“Address settings” on page 481
WdP	1	Connector for watchdog and 5 V power signal, connects to Controller backplane	“Controller backplane CPB-0001” on page 91 Cable: PDC-IOS05, see “PDC-IOS05” on page 838.
WD1 to WD3[1]	3	Connector to enable external watchdog grouping	See the *Safety Manual*.

1 On delivery, a triple jumper is placed and no watchdog grouping is used.
Watchdog grouping can be used for each group (WD1 corresponds to slot 1—6, WD2 to slot 7—12, WD3 to slot 13—18) by removing the jumper from the WDx connector for that group, and connecting the WDx connector to the watchdog group relais (See the *Safety Manual*).

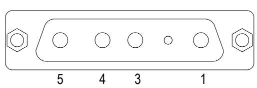
Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



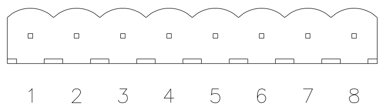
	IP1
1	IP slot 1—9
3	0 V
4	0 V
5	IP slot 10—18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



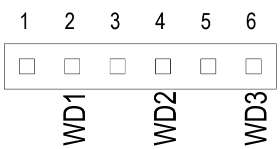
	EP3	EP2	EP1
1	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The back view and pin allocation of the WdP connector is:



	WdP
1	nc
2	nc
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	nc
8	nc

The back view and pin allocation of the WD jumper is:

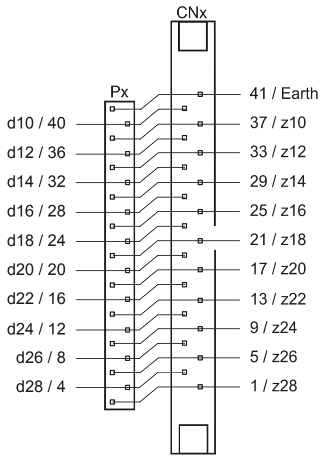


	WD
1	WDR of CP1 and CP2
2	WD of slot 1, 2, 3, 4, 5 and 6
3	WDR of CP1 and CP2
4	WD of slot 7, 8, 9, 10, 11 and 12
5	WDR of CP1 and CP2
6	WD of slot 13, 14, 15, 16, 17 and 18

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 51 on page 104 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

Figure 51 Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector



Horizontal IO bus backplane for non-redundant IO: IOBUS-HBS

Figure 48 on page 99 shows the IOBUS-HBS (in the top of the chassis).

Figure 52 on page 104 shows a front view of a filled IOCHAS-0001S with the cover opened.

Figure 53 on page 105 shows a front view of a filled IOCHAS-0001S with the cover closed.

Table 11 on page 105 lists the connectors present on the IOBUS-HBS.

Figure 52 Front view of a filled, open IOCHAS-0001S

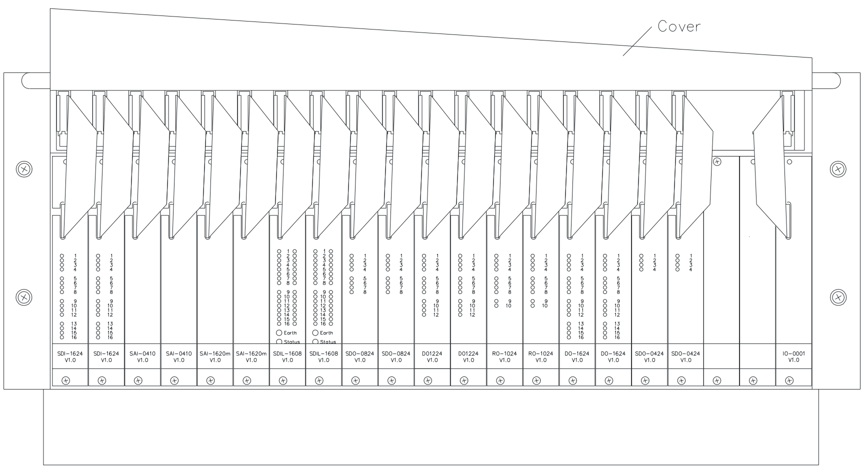


Figure 53 Front view of a filled, closed IOCHAS-0001S

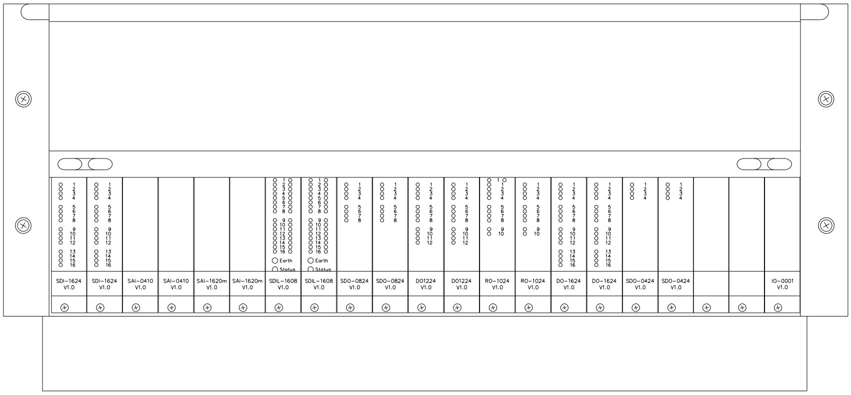
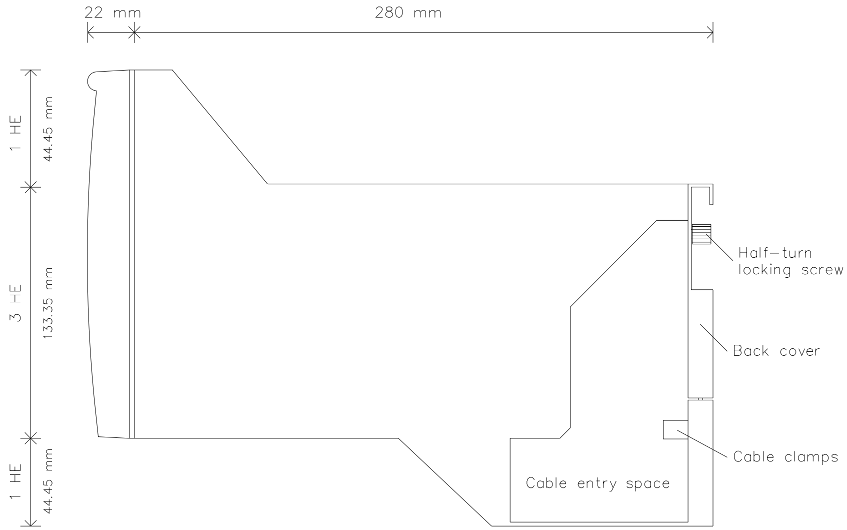


Table 11 Connectors on the IOBUS-HBS

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, located at slot 1 to 18	“Input modules” on page 289 “Output modules” on page 343
Flatcable connector	1	Connector for IO extender IO-0001, slot 21	“IO-0001” on page 479
20-pin flatcable assembly	1	Flatcable to the connector on the middle of the IO-0001 module	“IO-0001” on page 479

Figure 54 Side view of the IOCHAS-0001S



Technical data

General	Type number[1]:	FS-IOCHAS-0001S FC-IOCHAS-0001S
	Approvals:	CE, UL, CSA, TUV, FM
Power	5V-R:	35 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see Figure 54 on page 106 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,5 kg

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

IOCHAS-0001R

IO chassis for redundant IO modules (Safety Manager)

Description

The IOCHAS-0001R is a chassis for up to 9 pairs of redundant IO modules.

It consists of the following components:

Table 12 Components of the FS-IOCHAS-0001R[1] V1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 108
FS-IOB-0001R[1]	1	IO Backplane for redundant IO	page 109
FS-IO-0001[1] V1.0	2	IO Extender modules, slot 20 and 21	page 479
FS-IOBUS-HBR[1] V1.0	1	Horizontal IO bus backplane for redundant IO	page 113
Blind front	1	Located at slot 19	

1 FS-type modules are non conformal coated modules.

Table 13 Components of the FC-IOCHAS-0001R[1] CCV1.0

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 108
FS-IOB-0001R	1	IO Backplane for redundant IO	page 109
FC-IO-0001[1] CCV1.0	2	IO Extender modules, slot 20 and 21	page 479
FC-IOBUS-HBR[1] CCV1.0	1	Horizontal IO bus backplane for redundant IO	page 113
Blind front	1	Located at slot 19	

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters ‘CC’ preceding the version number.

Figure 55 Front view of an empty IOCHAS-0001R

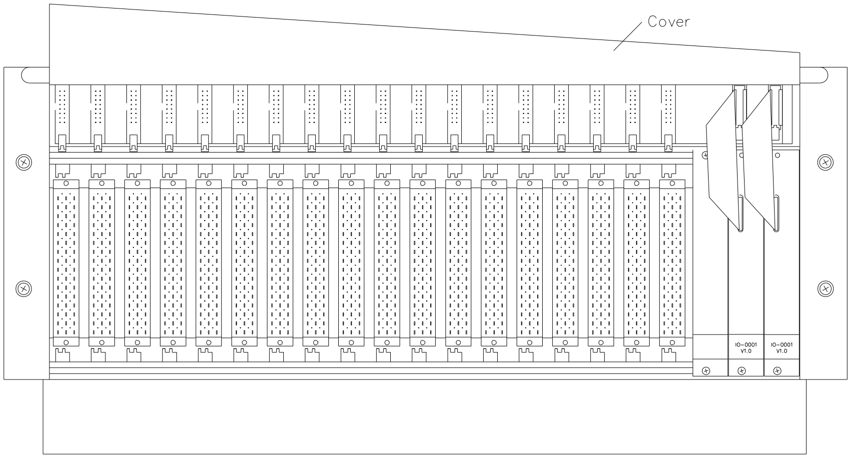


Figure 55 on page 108 shows the front side of an empty IOCHAS-0001R with the front cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis. In the IOCHAS-0001R, slots 1 to 18 are available for IO modules. They are configured in pairs.

The IO modules in the odd numbered slots (and the IO-0001 in slot 20) are controlled by Control Processor 1.
The IO modules in the even numbered slots (and the IO-0001 in slot 21) are controlled by Control Processor 2.

Slot 19 cannot be used.

Slot 20 and slot 21 contain the IO-0001 modules.
The IOB-0001R provides the 18 IO-connectors in the middle of the chassis.
The IOBUS-HBR provides the 18 flatcable-connectors in the top of the chassis.

IO Housing

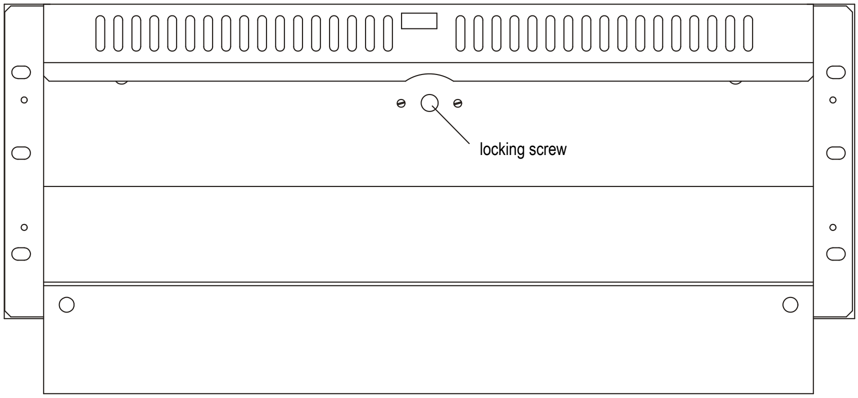
The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A cover plate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tag number assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see Figure 56 on page 109).

Figure 56 Back view of a closed IOCHAS-0001R



Attention

The IO back cover plate will be completely removed from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

Figure 61 on page 114 shows a side view of the IOCHAS-0001R.

IO Backplane for redundant IO: IOB-0001R

The front of the IOB-0001R backplane is visible in the middle of Figure 55 on page 108.

Figure 57 on page 110 shows the back of the IOCHAS-0001R with the back-cover removed.

Table 14 on page 110 describes the connectors on the IOB-0001R.

Figure 57 back view of an open IOCHAS-0001R

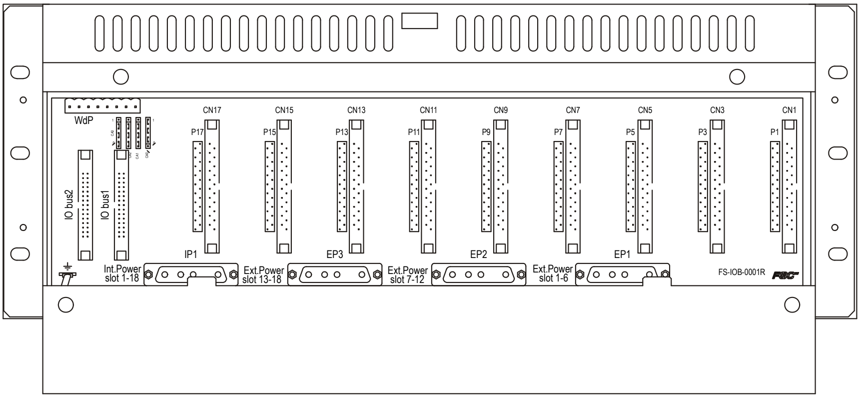


Table 14 Connectors on the IOB-0001R

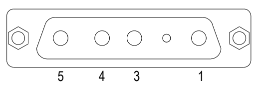
Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	For IO modules, slot 1 to 18	“Input modules” on page 289 “Output modules” on page 343
48-pin female chassis connector	2	For IO extender IO-0001, slot 20 and 21	“IO-0001” on page 479
Back side			
IO bus1	1	For IOBUS-CPIO (IO bus to Control Processor 1)	“IOBUS-CPIO” on page 491
IO bus2	1	For IOBUS-CPIO (IO bus to Control Processor 2)	“IOBUS-CPIO” on page 491
CN1, CN3, CN5, CN7, CN9, CN11, CN13, CN15 and CN17	9	For system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17	“SICC-0001/Lx” on page 715 “SICP-0001/Lx” on page 718
P1, P3, P5, P7, P9, P11, P13, P15 and P17	9	For IO converter modules, slot 1, 3, 5, 7, 9, 11, 13, 15, and 17	“Input converter modules” on page 321 “Output converter modules” on page 407
IP1	1	For internal power, slot 1 to 18	Cable: FS-PDC-IOIP1, see “PDC-IOxPx” on page 809

Table 14 Connectors on the IOB-0001R *(continued)*

Connector	**Amount**	**Description**	**See**
EP1	1	For external power, slot 1 to 6	Cable: FS-PDC-IOEP1, see “PDC-IOxPx” on page 809
EP2	1	For external power, slot 7 to 12	Cable: FS-PDC-IOEP2, see “PDC-IOxPx” on page 809
EP3	1	For external power, slot 13 to 18	Cable: FS-PDC-IOEP3, see “PDC-IOxPx” on page 809
CA0 to CA3	4	Jumpers for defining the IO chassis address	“Address settings” on page 481
WdP	1	For watchdog and 5 V power signal, connects to Controller backplane	“Controller backplane CPB-0001” on page 91 Cable: PDC-IOR05, see “PDC-IOR05” on page 840.

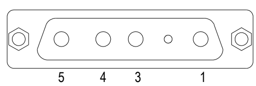
Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



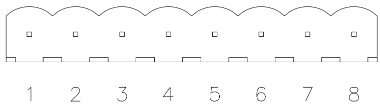
	IP1
1	IP slot 1, 3, 5, 7, 9, 11, 13, 15 and 17
3	0 V
4	0 V
5	IP slot 2, 4, 6, 8, 10, 12, 14, 16 and 18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	**EP2**	**EP1**
1	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The back view and pin allocation of the WdP connector is:

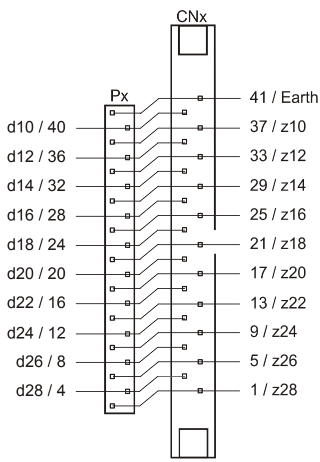


	WdP
1	5V of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16, 18 and 21
2	WD of CP2, slot 2, 4, 6, 8, 10, 12, 14, 16 and 18
3	ground
4	nc
5	nc
6	ground
7	5V of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15, 17 and 20
8	WD of CP1, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 58 on page 112 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

Figure 58 Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector



Horizontal IO bus backplane for redundant IO: IOBUS-HBR

Figure 55 on page 108 shows the IOBUS-HBR (in the top of the chassis).

Figure 59 on page 113 shows a front view of a filled IOCHAS-0001R with the cover opened.

Figure 60 on page 113 shows a front view of a filled IOCHAS-0001R with the cover closed.

Table 15 on page 114 lists the connectors on the IOBUS-HBR.

Figure 59 Front view of a filled, open IOCHAS-0001R

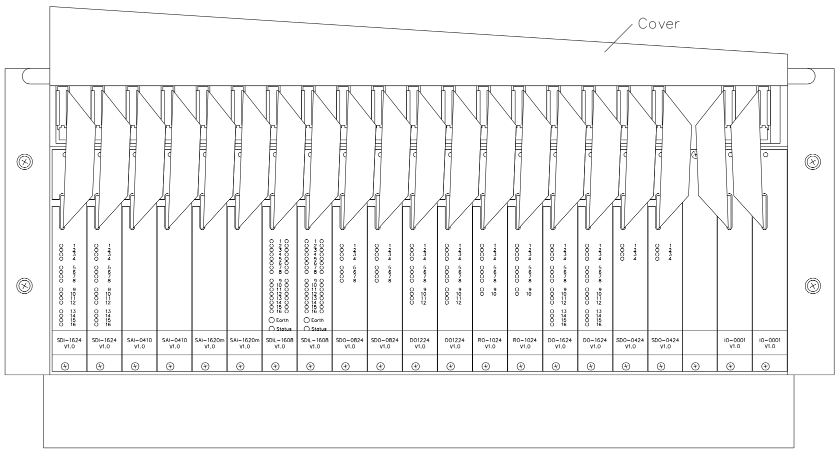


Figure 60 Front view of a filled, closed IOCHAS-0001R

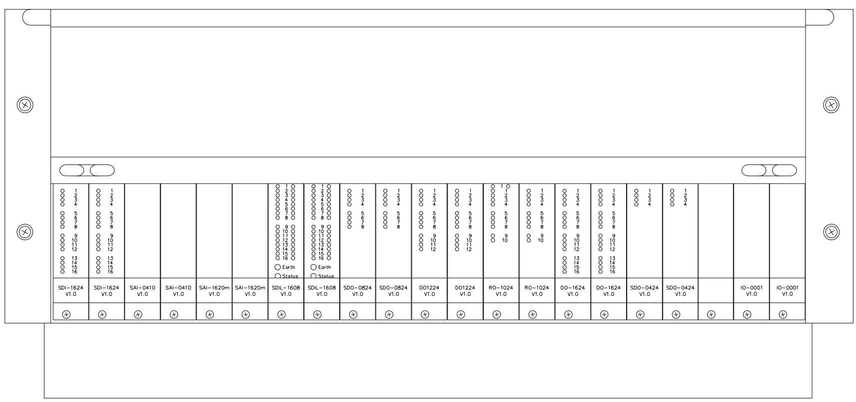
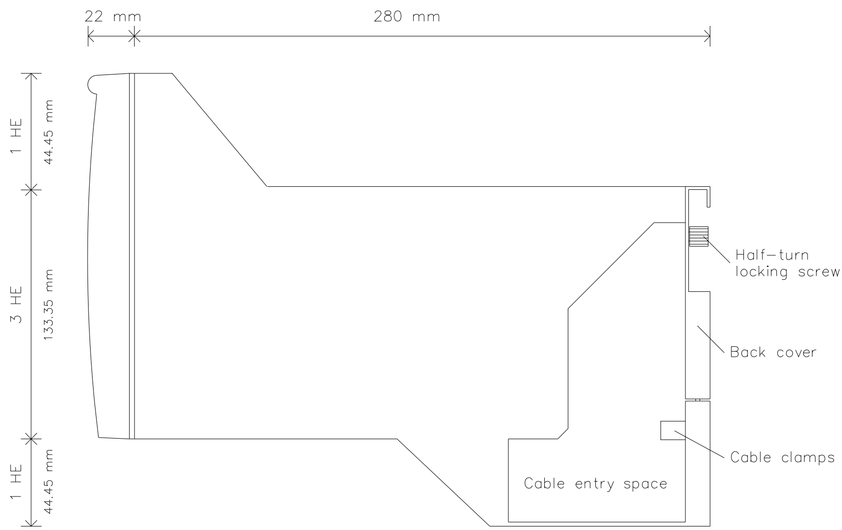


Table 15 Connectors on the IOBUS-HBR

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, slot 1 to 18	“Input modules” on page 289 “Output modules” on page 343
Flatcable connector	2	Connector for IO extender IO-0001, slot 20 and 21	“IO-0001” on page 479
10-pin flatcable assembly	2	Flatcables to the connectors on the middle of the IO-0001 modules	“IO-0001” on page 479

Figure 61 Side view of the IOCHAS-0001R



Technical data

General	Type number[1]:	FS-IOCHAS-0001R FC-IOCHAS-0001R
	Approvals:	CE, UL, CSA, TUV, FM
Power	5V-1:	35 mA (IO-0001 slot 20)
	5V-2:	35 mA (IO-0001 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see Figure 61 on page 114 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,5 kg

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

CPCHAS-0002

Chassis for redundant Controller (Safety Manager A.R.T.)

General

The Controller chassis CPCHAS-0002 is used to contain the Control Processor modules. Each Safety Manager has one Controller chassis. The Controller chassis is generally located at the top position in the cabinet, and the IO chassis at lower positions.

A Controller chassis contains the following components:

- Controller housing (see "Controller housing" on page 116)
- Controller backplane CPB-0002 (see "Controller backplane CPB-0002" on page 120)

Controller housing

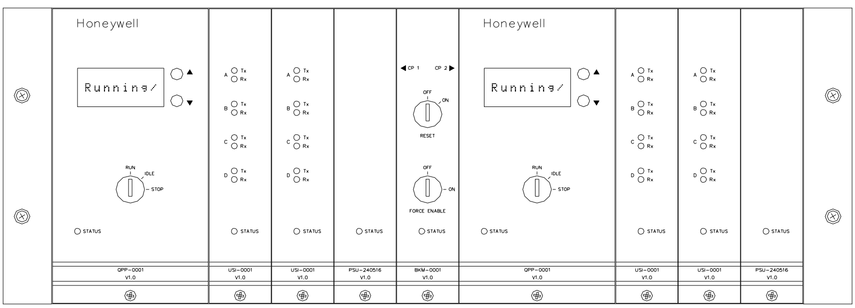
The Controller housing has been designed specifically for Safety Manager. It is a 19" housing that is open at the front and covered at the back.

Control Processor modules are placed in the chassis through the front of the housing with the use of module guides, which are located at the bottom and top plate of the housing.

The modules are locked in the chassis with the quarter turn fasteners, located below the module-grips.

Figure 62 on page 116 shows the front of a filled redundant Controller chassis.

Figure 62 Front view of a redundant Controller chassis

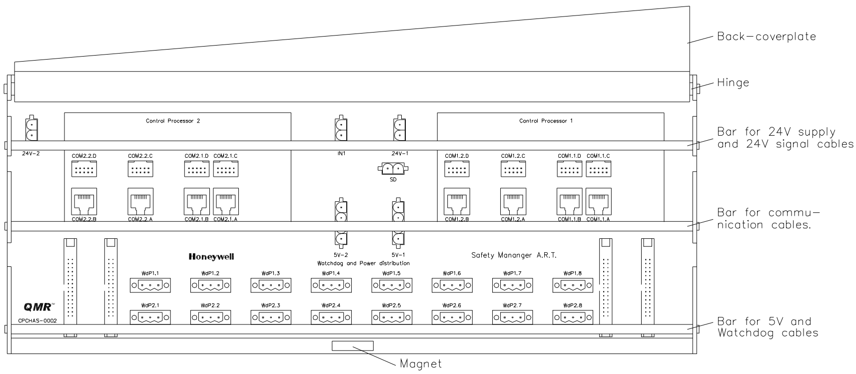


The back of the housing is covered by a magnetically locked back cover plate, which can be swung upwards to reveal the Controller backplane.

Cables must be tie-wrapped to one of the three horizontal bars at the back of the housing, to lead them towards the side of the chassis.
The top bar is reserved for the 24V-supply and 24V-signal wires/cables.
The middle bar is reserved for the communication cables.
The bottom bar is reserved for the 5V and Watchdog cables (WdPx and 5V-x).

Figure 63 on page 117 shows the back of an empty Controller chassis.

Figure 63 Back view of an empty Controller chassis



Location of Control Processor modules

The Controller chassis CPCHAS-0002 contains all Control Processor modules.

Table 16 on page 118 shows the location of the Control Processor modules in a redundant Controller (as seen from the front of the cabinet). As you can see, all Control Processor modules are doubled in a redundant Controller configuration, with the exception of the Battery and Key switch module, which is shared by both Control Processors.

Table 16 Distribution of the various Control Processor modules in the Controller chassis

Redundant Controller								
C P U 1	C O M 1 .1	C O M 1 .2	P S U 1	B K M	C P U 2	C O M 2 .1	C O M 2 . 2	P S U 2

Legend:

Item	**Description**	**See**
CPU1	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	page 253
COM1.1	the first communication module of the first Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275
COM1.2	the second communication module of the first Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275
PSU1	the power supply module of the first Control Processor	
	PSU-240516 Power Supply Unit 24/5 Vdc, 16A	page 284
BKM	the battery and key switch module of (both) Control Processor(s)	
	BKM-0001 Battery and Key switch Module	page 277
CPU2	the processor module of the first Control Processor	
	QPP-0002 Quad Processor Pack	page 253
COM2.1	the first communication module of the second Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275

Table 16 Distribution of the various Control Processor modules in the Controller chassis *(continued)*

Redundant Controller		
COM2.2	the second communication module of the second Control Processor	
	USI-0001 Universal Safety Interface, or	page 266
	USI-0002 Universal Safety Interface, or	page 271
	BLIND-COM Dummy Communication Module	page 275
PSU2	the power supply module of the second Control Processor	
	PSU-240516 Power Supply Unit 24/5 Vdc, 16A	page 284

For each Quad Processor Pack, room is provided for two communication modules in the Controller chassis. Table 17 on page 119 shows possible locations for different combinations of communication modules.

Note

If only one communication module is used in a Control Processor, the module is placed in the COM1 slot (see Table 17 on page 119). A blind communication module (BLIND-COM) should be placed in all unused communication slots.

Table 17 Possible locations of communication modules in the Controller chassis

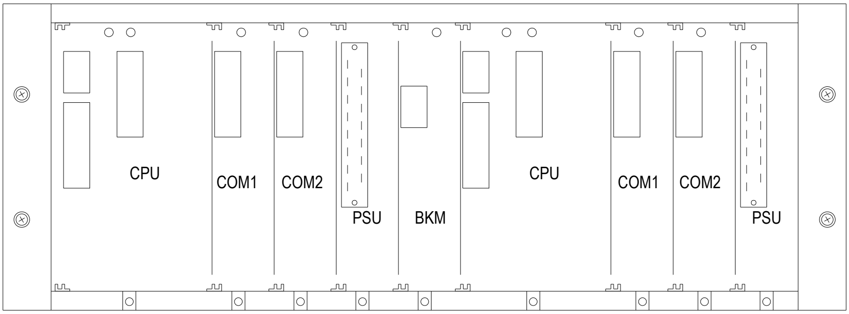
Number of modules	COM1 Slot	COM2 Slot
0	BLIND-COM	BLIND-COM
1	USI-0001 or USI-0002	BLIND-COM
2	USI-0001 or USI-0002	USI-0001 or USI-0002

Controller backplane CPB-0002

The Controller backplane is part of the Controller chassis. The front side contains the connectors for the Control Processor modules. The keying pins in the backplane connect the module housings with ground.

Figure 64 on page 120 shows the front view of an empty redundant Controller chassis, showing the Controller backplane.

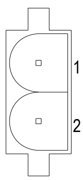
Figure 64 Front view of an empty redundant Controller chassis



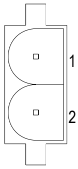
The back side of the Controller backplane contains all the connectors for signals that go in or out of the Controller. These connectors are visible when the back cover plate is swung upwards (see Figure 63 on page 117).

Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:

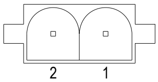
		**24V-1**	**24V-2**
	1	+24V for CP1	+24V for CP2
	2	0V for CP1	0V for CP2

The back view and pin allocation of the IN1 connectors are:



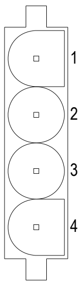
	IN1
1	+24V_red
2	input1

The back view and pin allocation of the SD connector is:



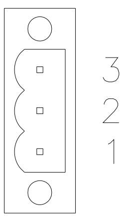
	SD
1	+24V_sd
2	input

The back view and pin allocation of the 5V-2 and 5V-1 connectors are:



	5V-2	5V-1
1	ground	ground
2	WD of CP2	WD of CP1
3	ground	ground
4	5V of CP2	5V of CP1

The back view and pin allocation of the sixteen WdPx connectors are:



	WdP1.x	WdP2.x
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

Connector function

Table 18 on page 122 describes the function of the connectors on the back side of the Controller backplane.

Table 18 Connectors at the back side of the Controller backplane

Group	Name	Connector type	Used for
Control Processor 1	Com1.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com1.1.B	RJ45	
	Com1.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com1.1.D	10-pin male	
	Com1.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com1.2.B	RJ45	
	Com1.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com1.2.D	10-pin male	
Control Processor 2	Com2.1.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM1 location
	Com2.1.B	RJ45	
	Com2.1.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM1 location
	Com2.1.D	10-pin male	
	Com2.2.A	RJ45	Ethernet communication channels 1 and 2 of the communication module in the COM2 location
	Com2.2.B	RJ45	
	Com2.2.C	10-pin male	General purpose communication channels 3 and 4 of the communication module in the COM2 location
	Com2.2.D	10-pin male	
IO bus 1	IO bus1.1	Flat cable connector	first own IO bus of Control Processor 1 and first redundant IO bus of Control Processor 2
	IO bus2.1	Flat cable connector	first own IO bus of Control Processor 2 and first redundant IO bus of Control Processor 1
IO bus 2	IO bus1.2	Flat cable connector	second own IO bus of Control Processor 1 and second redundant IO bus of Control Processor 2
	IO bus2.2	Flat cable connector	second own IO bus of Control Processor 2 and second redundant IO bus of Control Processor 1

Table 18 Connectors at the back side of the Controller backplane *(continued)*

Group	Name	Connector type	Used for
Watchdog and Power[1] distribution	WdP1.1	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 1[2]
	WdP2.1	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 1
	WdP1.2	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 2
	WdP2.2	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 2
	WdP1.3	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 3
	WdP2.3	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 3
	WdP1.4	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 4
	WdP2.4	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 4
	WdP1.5	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 5
	WdP2.5	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 5
	WdP1.6	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 6
	WdP2.6	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 6
	WdP1.7	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 7
	WdP2.7	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 7
	WdP1.8	3-pin male connector	Watchdog and Power of CP 1 to IO chassis 8
	WdP2.8	3-pin male connector	Watchdog and Power of CP 2 to IO chassis 8

Table 18 Connectors at the back side of the Controller backplane *(continued)*

Group	Name	Connector type	Used for
Power	24V-1	2-pin male connector	24V for Control Processor 1 (for cable details see “PDC-CP24” on page 807).
	24V-2	2-pin male connector	24V for Control Processor 2 (for cable details see “PDC-CP24” on page 807).
	5V-1	4-pin male connector	5V and Watchdog of Control Processor 1. This connector is used to distribute these signals to other (extension) cabinets using a: • PDB-CPX05, for more information see “PDC-CPX05” on page 844, or • PDB-ARTX05, for more information see “PDB-ARTX05” on page 727, or • PDB-ARTF05 (for more information see “PDB-ARTF05” on page 835).
	5V-2	4-pin male connector	5V and Watchdog of Control Processor 2. This connector is used to distribute these signals to other (extension) cabinets using a: • PDB-CPX05, for more information see “PDC-CPX05” on page 844, or • PDB-ARTX05, for more information see “PDB-ARTX05” on page 727, or • PDB-ARTF05 (for more information see “PDB-ARTF05” on page 835).
Various	SD	2-pin male connector	Connector for an Emergency Shut Down system. The chassis is delivered with the LINK-SD link placed. This link is required if the Emergency Shut Down function is not used (see also QPP data sheets “QPP-0002” on page 253 and “SICP-0002/L3” on page 722).
	IN1	2-pin male connector	24 Volt non-safety related general purpose input. This input can generate an interrupt (on the rising edge) e.g. for external clock synchronization (see also “BKM-0001” on page 277 and “SICP-0002/L3” on page 722).

1 Watchdog and 5 Volt of Control Processor 1 and Control Processor 2.

2 The chassis numbers mentioned here are defined by jumpers on the IO backplane.

Technical data

General	Type number:	FS-CPCHAS-0002 V1.1
	Approvals:	CE; UL, CSA, TUV, FM pending
Power	5V-1:	0.05 A
	5V-2:	0.05 A
Dimensions	Height:	4 HE (177 mm, 7 in)
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	5.8 kg, 12.8 lb

IOCHAS-0002S

IO Chassis for non-redundant IO modules (Safety Manager A.R.T.)

Description

The IOCHAS-0002S is a chassis for up to 18 non-redundant IO modules.

It consists of the following components:

Table 19 Components of the FC-IOCHAS-0002S

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 127
FS-IOB-0002S	1	IO Backplane for non-redundant IO (Safety Manager A.R.T.)	page 128
FC-IO-0002	2	IO Extender modules, slot 20 and 21 (Safety Manager A.R.T.)	page 488
FS-IOBUS-HB2S	1	Horizontal IO bus backplane for non-redundant IO (Safety Manager A.R.T.)	page 132
FC-IOBUS-HB2A	1	Horizontal IO bus transfer board at slot 19 (Safety Manager A.R.T.)	page 133
Blind front	1	Located at slot 19	

Figure 65 Front view of an empty IOCHAS-0002S

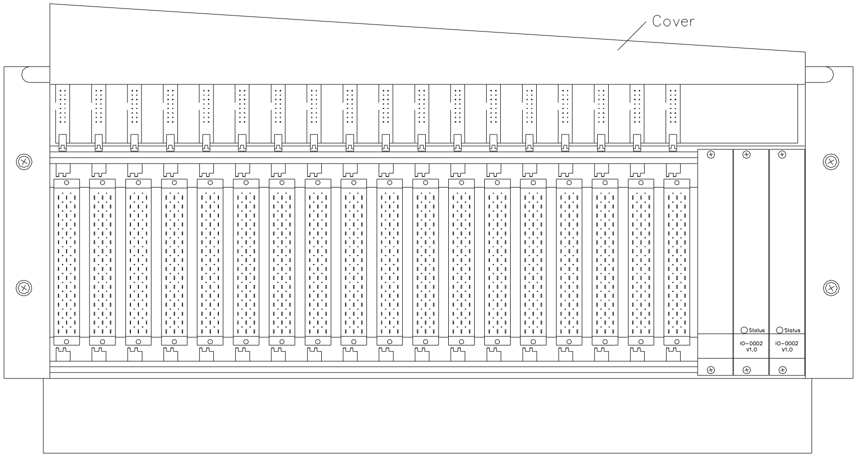


Figure 65 on page 127 shows the front side of an empty IOCHAS-0002S with the front-cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis.
In the IOCHAS-0002S, slots 1 to 18 are available for IO modules.

Behind the blind front at slot 19, IOBUS-HB2A is located.

Slot 20 and slot 21 contain the IO-0002 modules.
The IOB-0002S provides the 18 IO-connectors in the middle of the chassis.
The IOBUS-HB2S provides the 18 flatcable-connectors in the top of the chassis.

IO Housing

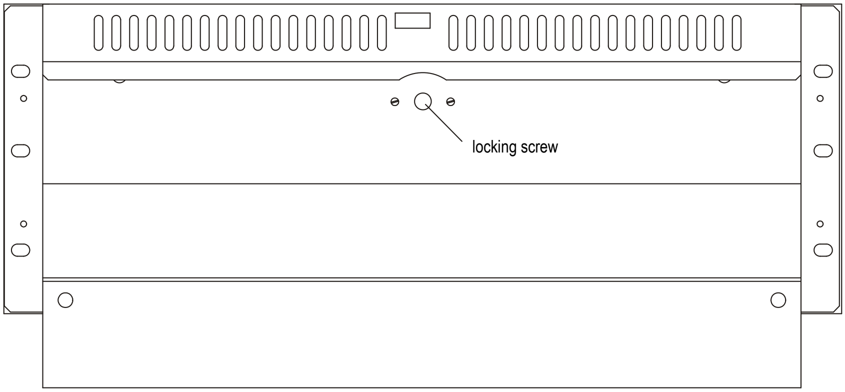
The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A coverplate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tagnumber assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see Figure 66 on page 128).

Figure 66 Back view of a closed IOCHAS-0002S



Attention

The IO back cover plate will be completely unattached from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

Figure 72 on page 134 shows a side view of the IOCHAS-0002S.

IO Backplane for non-redundant IO (Safety Manager A.R.T.): IOB-0002S

The front of the IOB-0002S backplane is visible in the middle of Figure 65 on page 127.

Figure 67 on page 129 shows the back of the IOCHAS-0002S with the back-cover removed.

Table 20 on page 129 describes the connectors present on the IOB-0002S.

Figure 67 Back view of an open IOCHAS-0002S

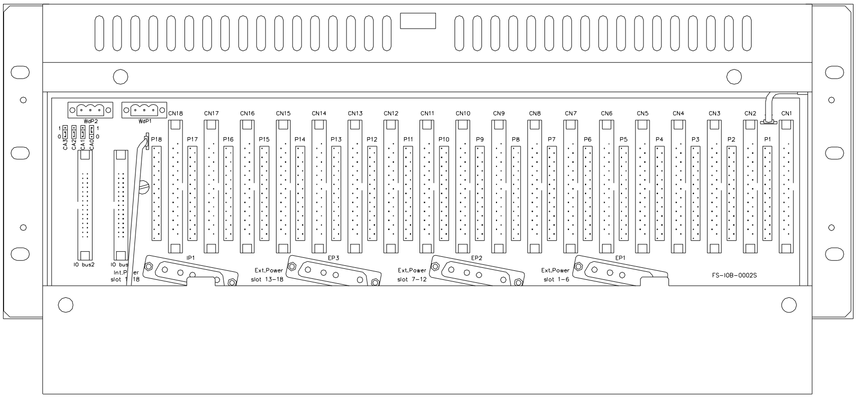


Table 20 Connectors on the IOB-0002S

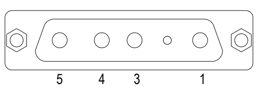
Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	Connectors for IO modules, slot 1 to 18	"Input modules" on page 289 "Output modules" on page 343
55-pin male chassis connector	1	For IOBUS-HB2A, slot 19	page 133
8-pin male power chassis connector	2	For IO extender IO-0001, slot 20 and 21	"IO-0002" on page 488
120-pin female chassis connector	2	For IO extender IO-0002, slot 20 and 21	"IO-0002" on page 488
Back side			
IO bus1	1	For IOBUS-CPIO (IO bus 1 to controller chassis)	"IOBUS-CPIO" on page 491
IO bus2	1	For IOBUS-CPIO (IO bus 2 to controller chassis)	"IOBUS-CPIO" on page 491
CN1 to CN18	18	Connector for system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1 to 18	"SICC-0001/Lx" on page 715 "SICP-0001/Lx" on page 718

Table 20 Connectors on the IOB-0002S

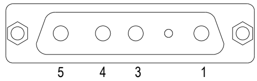
Connector	Amount	Description	See
P1 to P18	18	Connector for IO converter modules, slot 1 to 18	“Input converter modules” on page 321 “Output converter modules” on page 407
IP1	1	Connector for internal power, slot 1 to 18	Cable: FS-PDC-IOIP1, see “PDC-IOxPx” on page 809
EP1	1	Connector for external power, slot 1 to 6	Cable: FS-PDC-IOEP1, see “PDC-IOxPx” on page 809
EP2	1	Connector for external power, slot 7 to 12	Cable: FS-PDC-IOEP2, see “PDC-IOxPx” on page 809
EP3	1	Connector for external power, slot 13 to 18	Cable: FS-PDC-IOEP3, see “PDC-IOxPx” on page 809
CA0 to CA3	4	Jumpers for defining the IO chassis address	“Address settings” on page 481
WdP1	1	Connector for watchdog and 5 V of CP1	“Controller backplane CPB-0002” on page 120 Cable: PDC-ART05, see “PDC-ART05” on page 846
WdP2	1	Connector for watchdog and 5 V of CP2	“Controller backplane CPB-0002” on page 120 Cable: PDC-IOR05, see “PDC-ART05” on page 846

Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:

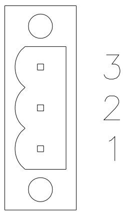
		IP1
		
	1	IP slot 1—9
	3	0 V
	4	0 V
	5	IP slot 10—18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	EP2	EP1
1	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

The back view and pin allocation of the WdPx connector (see Figure 67 on page 129) is:

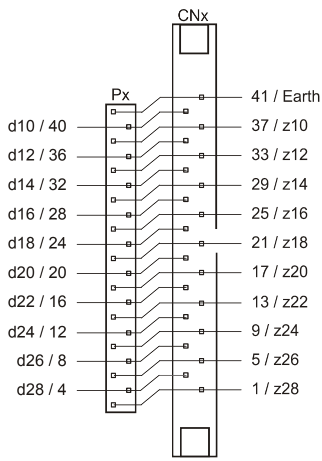


	WdP1	WdP2
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 68 on page 131 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

Figure 68 Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector



Horizontal IO bus backplane for non-redundant IO (Safety Manager A.R.T.): IOBUS-HB2S

Figure 65 on page 127 shows the IOBUS-HB2S (in the top of the chassis).

Figure 69 on page 132 shows a front view of a filled IOCHAS-0002S with the cover opened.

Figure 70 on page 132 shows a front view of a filled IOCHAS-0002S with the cover closed.

Table 21 on page 133 lists the connectors present on the IOBUS-HB2S.

Figure 69 Front view of a filled, open IOCHAS-0002S

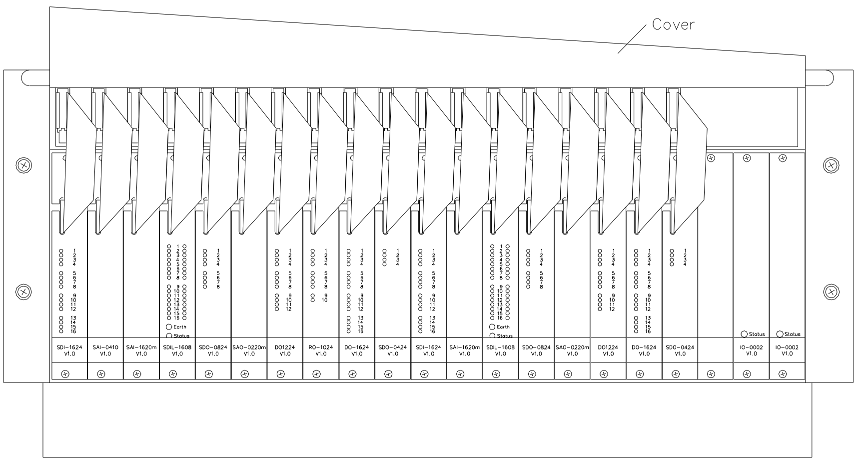


Figure 70 Front view of a filled, closed IOCHAS-0002S

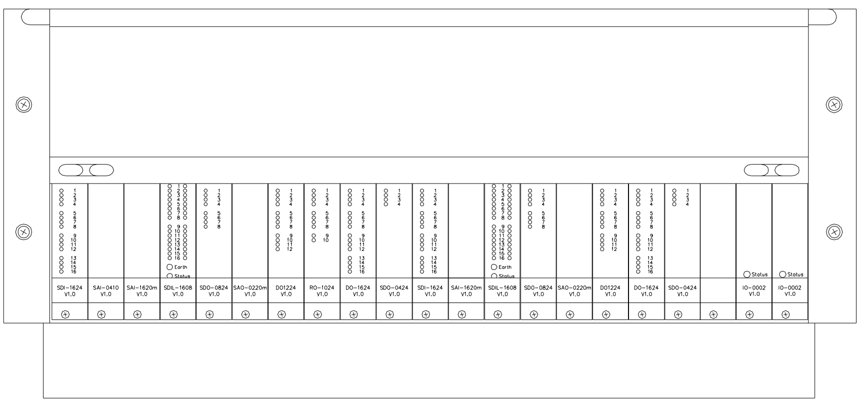


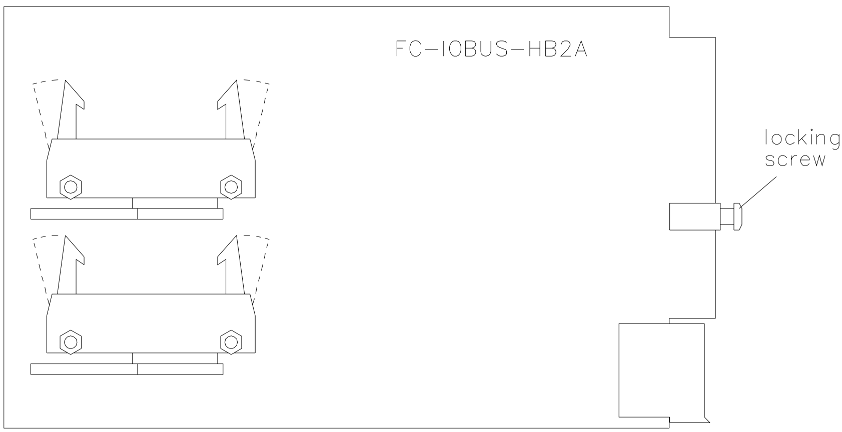
Table 21 Connectors on the IOBUS-HBS

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, located at slot 1 to 18	"Input modules" on page 289 "Output modules" on page 343
26-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A" on page 133
10-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A" on page 133

Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A

The IOBUS-HB2A board transfers the IO bus signals on the backplane to the Horizontal IO bus on the front of the chassis.

Figure 71 Component view of the IOBUS-HB2A board

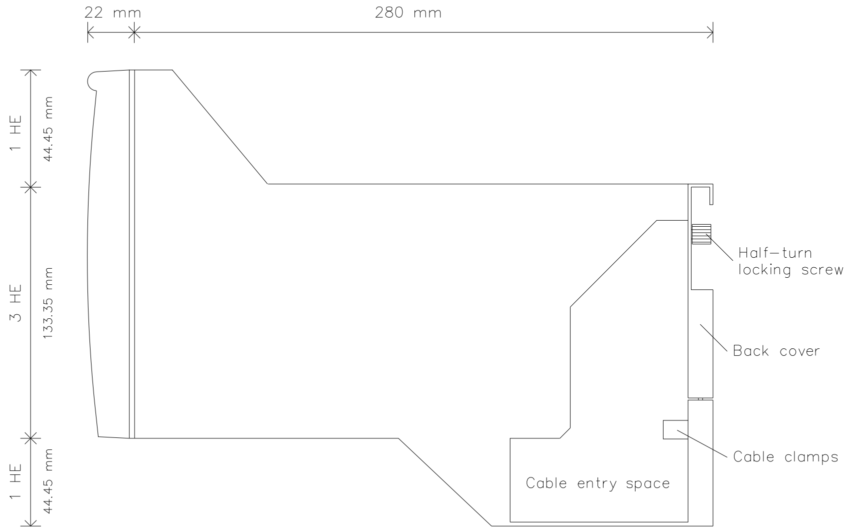


The IOBUS-HB2A is placed behind the blind front, at slot 19 of the IO chassis.

The IOBUS-HB2A is fixed on the IOB-0002S with the locking screw (see Figure 71 on page 133).

The two flatcables on (the rear of) the IOBUS-HB2S are connected to the two latches on the IOBUS-HB2A.

Figure 72 Side view of the IOCHAS-0002S



Technical data

General	Type number:	FC-IOCHAS-0002S
	Approvals:	CE; UL, CSA, TUV, FM pending
Power	5V-1:	100 mA (IO-0002 slot 20)
	5V-2:	100 mA (IO-0002 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see Figure 72 on page 134 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,7 kg, 19.2 lb

IOCHAS-0002R

IO chassis for redundant IO modules (Safety Manager A.R.T.)

Description

The IOCHAS-0002R is a chassis for up to 9 pairs of redundant IO modules.

It consists of the following components:

Table 22 Components of the FC-IOCHAS-0002R

Component	Amount	Description	See
IO housing	1	19 inch mechanical case including cover plates for up to 18 IO modules	page 136
FS-IOB-0002R	1	IO Backplane for redundant IO (Safety Manager A.R.T.)	page 137
FC-IO-0002	2	IO Extender modules, slot 20 and 21 (Safety Manager A.R.T.)	page 488
FS-IOBUS-HB2R	1	Horizontal IO bus backplane for redundant IO (Safety Manager A.R.T.)	page 141
FC-IOBUS-HB2A	1	Horizontal IO bus transfer board at slot 19 (Safety Manager A.R.T.)	page 142
Blind front	1	Located at slot 19	

Figure 73 Front view of an empty IOCHAS-0002R

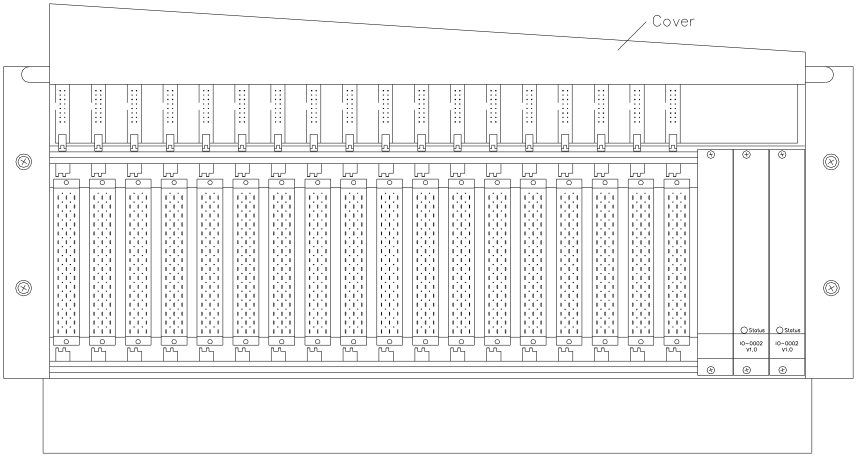


Figure 73 on page 136 shows the front side of an empty IOCHAS-0002R with the front cover raised.

A 19" chassis has 21 slots for modules (each 4TE wide). These slots are numbered 1 to 21, starting at the left-hand side of the chassis. In the IOCHAS-0002R, slots 1 to 18 are available for IO modules. They are configured in pairs.

Behind the blind front at slot 19, IOBUS-HB2A is located.

Slot 20 and slot 21 contain the IO-0002 modules.
The IOB-0002R provides the 18 IO-connectors in the middle of the chassis.
The IOBUS-HB2R provides the 18 flatcable-connectors in the top of the chassis.

IO Housing

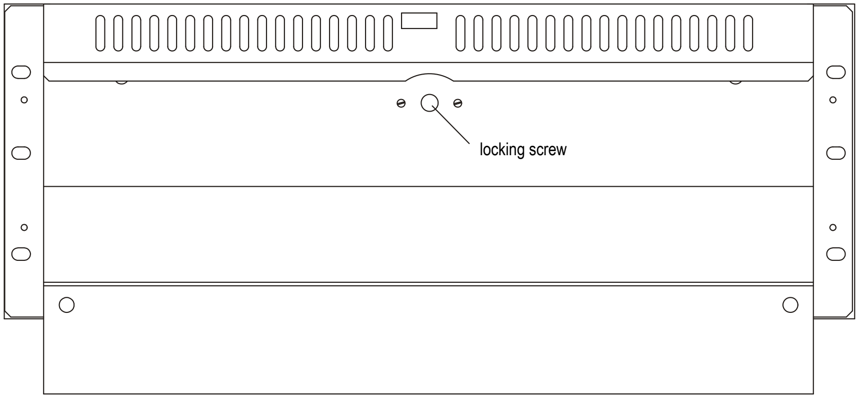
The IO housing is specifically designed for Safety Manager.

It is a 19" based housing.

A cover plate assembly at the front of the chassis shields the flatcables of the IO modules. This cover can be swung upwards to access the flatcables. To swing the cover upwards, unlock it by moving the two locking slides horizontally towards the middle of the chassis. The backside of the IO cover assembly provides room for a tag number assignment drawing.

The backside of the IO housing is covered by an IO back cover plate that can be removed by rotating the half-turn locking screw anti-clockwise (see Figure 74 on page 137).

Figure 74 Back view of a closed IOCHAS-0002R



Attention

The IO back cover plate will be completely removed from the IO chassis after the locking screw has been turned. Be careful not to drop it.

IO cable clamp support (with tie wrap) at the back of the IO housing leads all cables towards the side of the IO chassis.

Figure 80 on page 143 shows a side view of the IOCHAS-0002R.

IO Backplane for redundant IO (Safety Manager A.R.T.): IOB-0002R

The front of the IOB-0002R backplane is visible in the middle of Figure 73 on page 136.

Figure 75 on page 138 shows the back of the IOCHAS-0002R with the back-cover removed.

Table 23 on page 138 describes the connectors on the IOB-0002R.

Figure 75 back view of an open IOCHAS-0002R

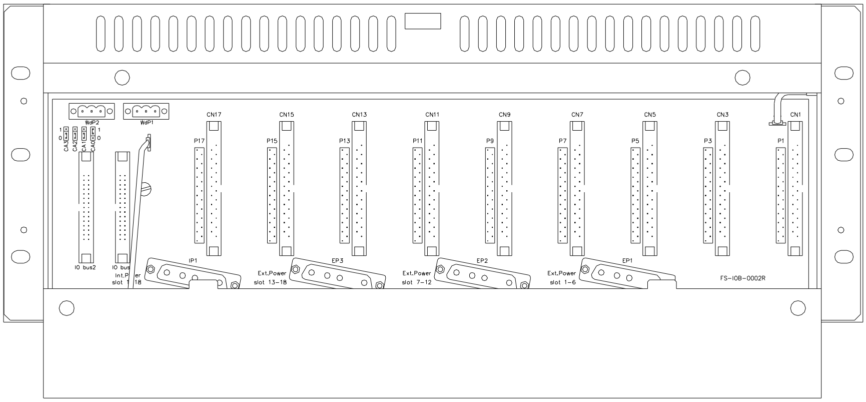


Table 23 Connectors on the IOB-0002R

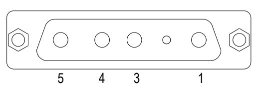
Connector	Amount	Description	See
Front side			
48-pin female chassis connector	18	For IO modules, slot 1 to 18	“Input modules” on page 289 “Output modules” on page 343
55-pin male chassis connector	1	For IOBUS-HB2A, slot 19	page 142
8-pin male power chassis connector	2	For IO extender IO-0002, slot 20 and 21	“IO-0002” on page 488
120-pin male chassis connector	2	For IO extender IO-0002, slot 20 and 21	“IO-0002” on page 488
Back side			
IO bus1	1	For IOBUS-CPIO (IO bus 1 to controller chassis)	“IOBUS-CPIO” on page 491
IO bus2	1	For IOBUS-CPIO (IO bus 2 to controller chassis)	“IOBUS-CPIO” on page 491
CN1, CN3, CN5, CN7, CN9, CN11, CN13, CN15 and CN17	9	For system interconnection cables SICC-0001/Lx or SICP-0001/Lx, slot 1, 3, 5, 7, 9, 11, 13, 15 and 17	“SICC-0001/Lx” on page 715 “SICP-0001/Lx” on page 718

Table 23 Connectors on the IOB-0002R

Connector	Amount	Description	See
P1, P3, P5, P7, P9, P11, P13, P15 and P17	9	For IO converter modules, slot 1, 3, 5, 7, 9, 11, 13, 15, and 17	"Input converter modules" on page 321 "Output converter modules" on page 407
IP1	1	For internal power, slot 1 to 18	Cable: FS-PDC-IOIP1, see "PDC-IOxPx" on page 809
EP1	1	For external power, slot 1 to 6	Cable: FS-PDC-IOEP1, see "PDC-IOxPx" on page 809
EP2	1	For external power, slot 7 to 12	Cable: FS-PDC-IOEP2, see "PDC-IOxPx" on page 809
EP3	1	For external power, slot 13 to 18	Cable: FS-PDC-IOEP3, see "PDC-IOxPx" on page 809
CA0 to CA3	4	Jumpers for defining the IO chassis address	"Address settings" on page 481
WdP1	1	Connector for watchdog and 5 V of CP1	"Controller backplane CPB-0002" on page 120 Cable: PDC-ART05, see "PDC-ART05" on page 846
WdP2	1	Connector for watchdog and 5 V of CP2	"Controller backplane CPB-0002" on page 120 Cable: PDC-IOR05, see "PDC-ART05" on page 846

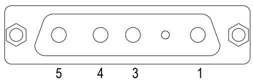
Pin allocation

The back view and pin allocation of the Internal Power connector IP1 is:



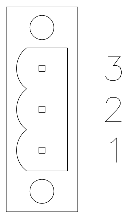
		IP1
	1	IP slot 1, 3, 5, 7, 9, 11, 13, 15 and 17
	3	0 V
	4	0 V
	5	IP slot 2, 4, 6, 8, 10, 12, 14, 16 and 18

The back view and pin allocation of the External Power connectors EP1, EP2 and EP3 are:



	EP3	**EP2**	**EP1**
1	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	0 V	0 V	0 V
4	0 V	0 V	0 V
5	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The back view and pin allocation of the WdPx connector (see Figure 75 on page 138) is:

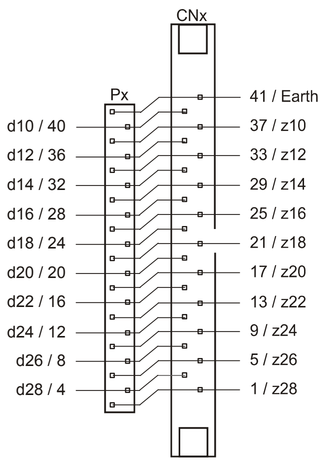


	WdP1	**WdP2**
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

The pin allocation of each respective input and output module can be found in the module datasheet.

Figure 76 on page 140 shows the pin mapping from an IO chassis connector at the front to both a SIC cable (CNx) connector and a converter (Px) connector at the back of the IO Chassis.

Figure 76 Pin mapping from IO connector to SIC cable (CNx) and converter (Px) connector



Horizontal IO bus backplane for redundant IO (Safety Manager A.R.T.): IOBUS-HB2R

Figure 73 on page 136 shows the IOBUS-HB2R (in the top of the chassis).

Figure 77 on page 141 shows a front view of a filled IOCHAS-0002R with the cover opened.

Figure 78 on page 141 shows a front view of a filled IOCHAS-0002R with the cover closed.

Table 24 on page 142 lists the connectors on the IOBUS-HB2R.

Figure 77 Front view of a filled, open IOCHAS-0002R

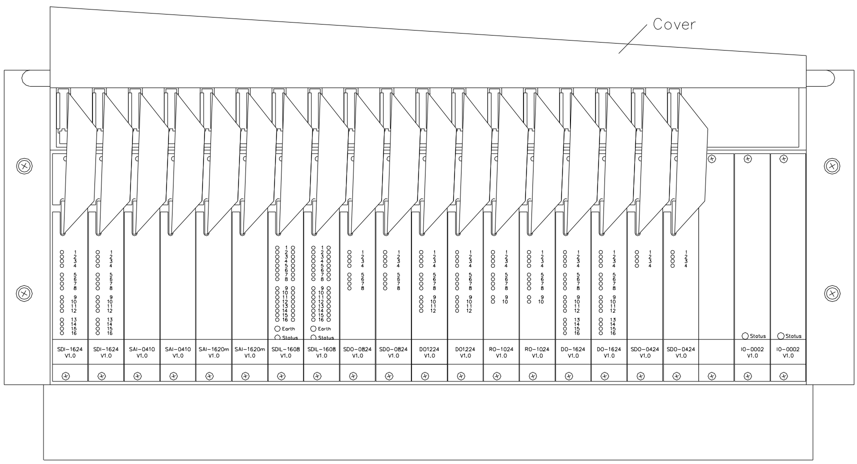


Figure 78 Front view of a filled, closed IOCHAS-0002R

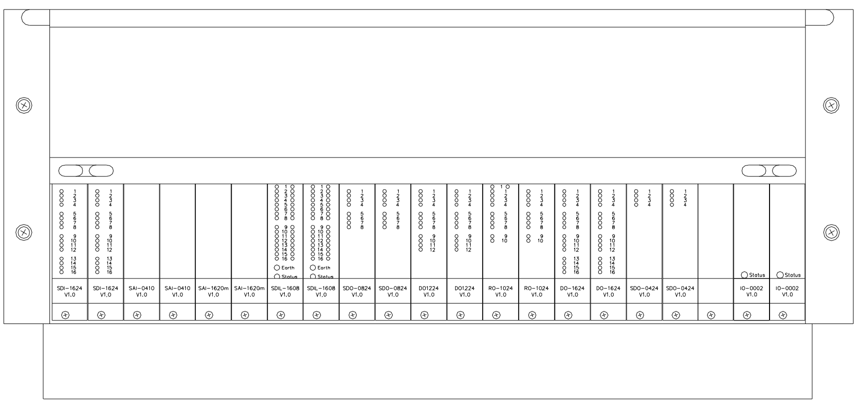


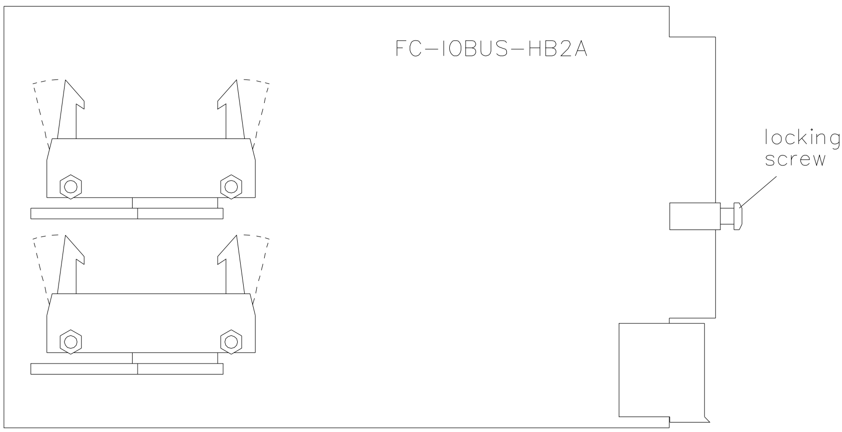
Table 24 Connectors on the IOBUS-HB2R

Connector	Amount	Description	See
Flatcable connector	18	Connectors for IO modules, slot 1 to 18	"Input modules" on page 289 "Output modules" on page 343
26-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A" on page 142
10-pin flatcable assembly	1	Flatcable to the latch on the IOBUS-HB2A	"Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A" on page 142

Horizontal IO bus transfer board (Safety Manager A.R.T.): IOBUS-HB2A

The IOBUS-HB2A board transfers the IO bus signals on the backplane to the Horizontal IO bus on the front of the chassis.

Figure 79 Component view of the IOBUS-HB2A board

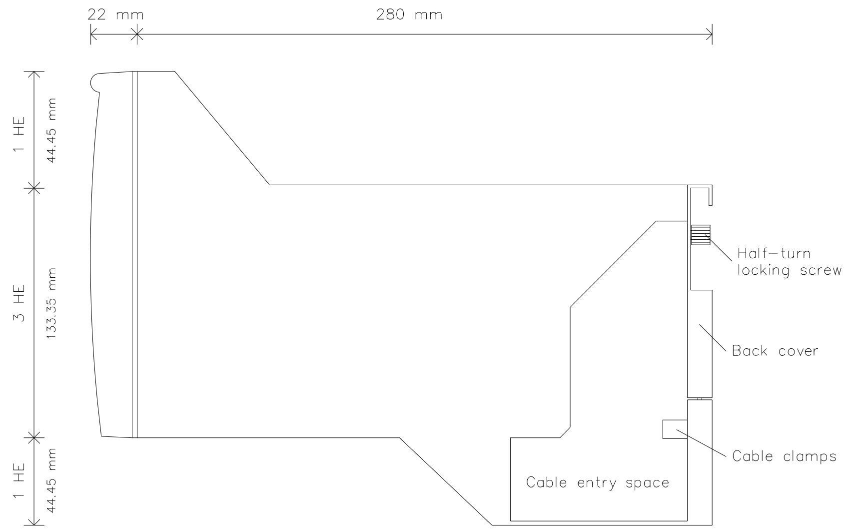


The IOBUS-HB2A is placed behind the blind front, at slot 19 of the IO chassis.

The IOBUS-HB2A is fixed on the IOB-0002R with the locking screw (see Figure 79 on page 142).

The two flatcables on (the rear of) the IOBUS-HB2R are connected to the two latches on the IOBUS-HB2A.

Figure 80 Side view of the IOCHAS-0002R



Technical data

General	Type number:	FC-IOCHAS-0002R
	Approvals:	CE; UL, CSA, TUV, FM pending
Power	5V-1:	100 mA (IO-0002 slot 20)
	5V-2:	100 mA (IO-0002 slot 21)
Dimensions	Height:	1 + 3 + 1 HE for first IO chassis 4 HE for every next IO chassis see Figure 80 on page 143 44.5 + 133.4 + 44.5 mm 1.75 + 5.25 + 1.75 in
	Width:	482.6 mm, 19 in
	Depth:	280 mm, 11 in
	Weight:	8,7 kg, 19.2 lb

Power supplies

6

This chapter describes the different types of power supplies and power feeders that can be used with the Safety Manager.

The following power supplies on AC plant power are described:

Power supply	See
PSU-UNI2450U	page 149
PSU-UNI4825U	page 159
PSU-UNI6020U	page 166
PSU-UNI11011U	page 173
1200 S 24 P067	page 187
1200 S 48 P073	page 195
RUSPSU-R	page 217
RUSPSU-S	page 221
PSU-UNI2412	page 225
PSUTA-0001	page 229

The following power feeders on DC plant power are described:

Power feeder	See
FS-FEEDER-24R	page 203
FS-FEEDER-48R	page 210

General info about power supplies

Power supplies are used to convert different Vac input voltages to a specific Vdc output voltage, which is used by Safety Manager.

Table 25 on page 146 shows all suitable power supplies and their input and output voltages.

Table 25 power supplies and their input and output voltages

Power supply	Input feeder	Output feeder
PSU-UNI2450	110—240 Vac	24 Vdc, 50 A
PSU-UNI4825U	110—240 Vac	48 Vdc, 25A
PSU-UNI6020U	110—240 Vac	60 Vdc, 20A
PSU-UNI11011U	110—240 Vac	110 Vdc, 11A
1200 S 24 P067	100—132 Vac, 200—264 Vac, 230—340 Vdc	24 Vdc 45A
1200 S 48 P073	100—132 Vac, 200—264 Vac, 230—340 Vdc	48 Vdc 25 A

Table 26 on page 146 also shows the available power feeders required to process DC plant power. They can be wired identical to the power supplies.

Table 26 power feeders and their input and output voltages

Feeder type	Input feeder	Output feeder
FS-FEEDER-24R	24 Vdc	24 Vdc, 63 A
FS-FEEDER-48R	48 Vdc	48 Vdc, 63 A

In addition to these, Power Supply Unit PSU-240516 is located in the Controller chassis. It is described in the chapter about Control Processor modules, in section “PSU-240516” on page 284.

Power supply configurations

Note:

For more information and calculation examples see the *Planning and Design Guide*.

Non-redundant power supply units (N configuration)

In this configuration the number of PSUs chosen matches the required power. If the system has a non-redundant Controller there may be no need for redundancy in the PSU configuration.

AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSU(s) deliver(s) sufficient power for Safety Manager.
- A failure in one of the PSUs may lead to a system stop with undefined results.
- A failure in the mains power leads to a system stop with undefined results.

See Figure 81 on page 148 for details.

Redundant power supply units (N+1 configuration)

If the system has a redundant Controller, it is recommended to have a PSU configuration that is tolerant to a PSU failure. In the N+1 configuration one extra PSU is placed besides the PSU(s) necessary to deliver the required power.

AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSUs can supply more power than the Safety Manager system requires.
- System continues normal operation when one PSU fails (single-fault tolerant).
- A failure in the mains power leads to a system stop with undefined results.

See Figure 81 on page 148 for details.

Fully redundant power supply units (Nx2 configuration)

If the system has a redundant Controller, it is recommended to have a PSU configuration that is tolerant of a PSU or mains failure. In the Nx2 configuration the required PSU capacity is doubled. The the second part is connected to an independent power feeder system.

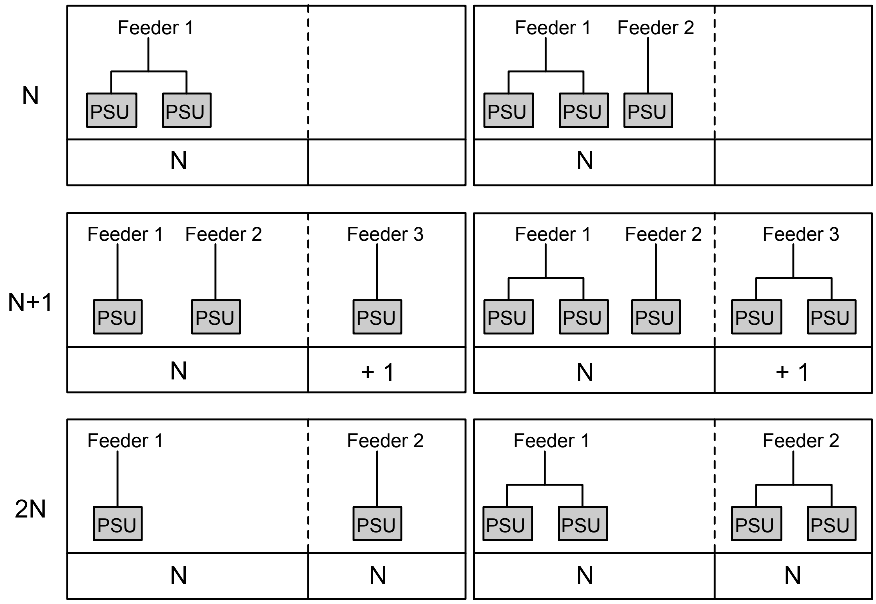
AC power feeders supply the power for the entire Safety Manager system. To limit the load on the feeder, you are advised to put no more than 2 power supplies on one feeder.

This configuration has the following characteristics:

- The PSUs can deliver twice the power required by the Safety Manager system.
- System continues normal operation when one PSU fails (single-fault tolerant).
- System continues normal operation upon a failure in the power mains.

See Figure 81 on page 148 for details.

Figure 81 Power Supply Units configurations (2 examples for each configuration)



Power feeder configurations

If a customer provides DC power feeder(s) for the Safety Manager system, power supply units (PSUs) may not have to be installed. However the Honeywell SMS Feeder Unit 24V or Feeder Unit 48V is installed.

If a customer provides one DC power feeder cable for the entire Safety Manager system, a single failure in the mains power leads to a system stop with undefined results.

Redundant DC power feeders are normally supplied with the Safety Manager system. In this case, de coupling diodes have to be used.

The Honeywell SMS Feeder Units already contain de coupling diodes.

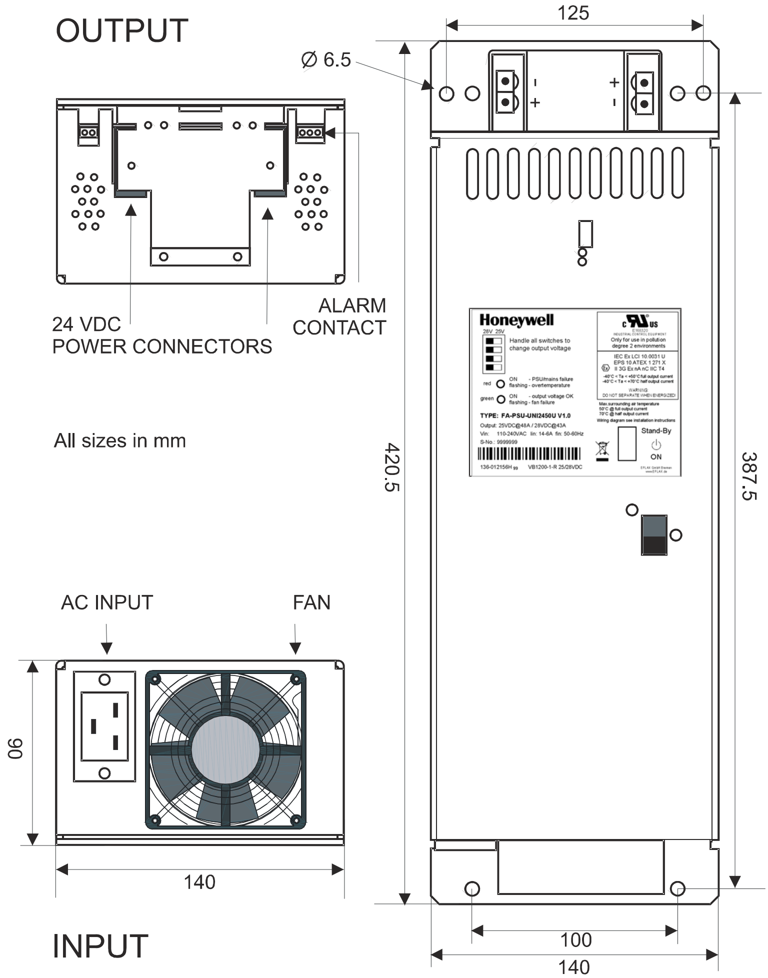
PSU-UNI2450U

25—28 Vdc Power supply (1200 W) – UL508 approved

Description

The PSU-UNI2450U power supply is a UL approved switched-mode DC power supply with a high efficiency (>87% at 230 Vac). It accepts a wide range of input voltages to provide 25 Vdc and 48 A output or 28 Vdc and 43 A output.

Figure 82 Top, bottom and front view of the PSU-UNI2450U power supply



Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- Under-voltage alarm
- an output diode for parallel operation
- Optimum protection against continuous overload and short-circuiting.

The LEDs on the front panel indicate the following status:

green LED	on	PSU in operation; output OK
	off	PSU swithed off
	flashing	fan does not reach required speed
red LED	on	PSU/MAINS failure, or in stand-by mode
	off	no failure
	flashing	temperature too high

Hardware control features

The PSU-UNI2450U power supply has the following hardware control features:

- Power switch
- An output adjustment selector switch (25 Vdc or 28 Vdc).
- An alarm contact.

Each of these features is discussed in more detail below.

Power switch

Attention:

Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI2450U before you disconnect it.

With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

Output adjustment selector switch

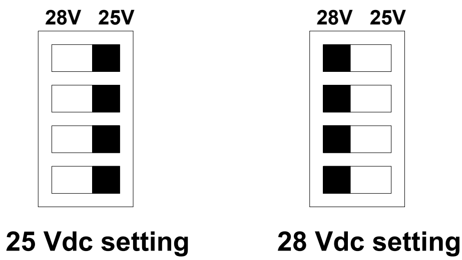
Attention:

Only change the dip-switch settings when the power supply has been switched off.

To adjust the output to 28 Vdc (e.g. for UPS applications), *all four* dip-switches in the PSU front need to be set in their left position, as shown in Figure 83 on page 151.

Default factory setting of the dip-switch is 25 Vdc.

Figure 83 Dip-switch setting to set output voltage

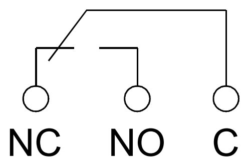


Alarm contact

The PSU-UNI2450U has an alarm contact used for voltage monitoring.

Figure 84 on page 151 shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 22Vdc.

Figure 84 Alarm contact state with output voltage above 22 Vdc



Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see Figure 85 on page 152).

Notes:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

Figure 85 Vertical mounting of the PSU-UNI2450U power supply

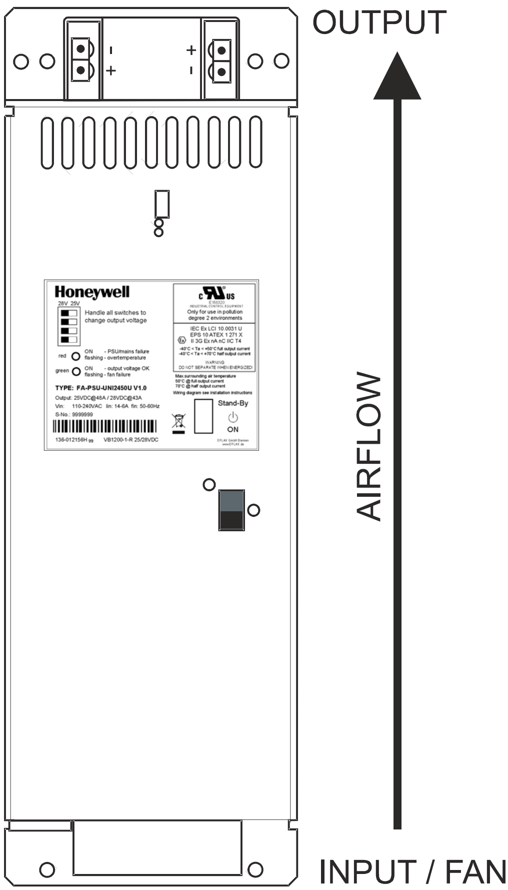
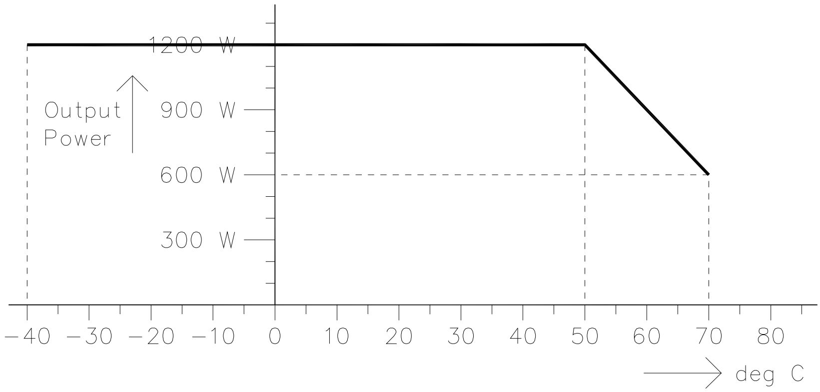


Figure 86 on page 153 shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

Figure 86 Derating curve[1] for the PSU-UNI2450U power supply.



1 Operation outside these perimeters may cause a temporary PSU shut-down.

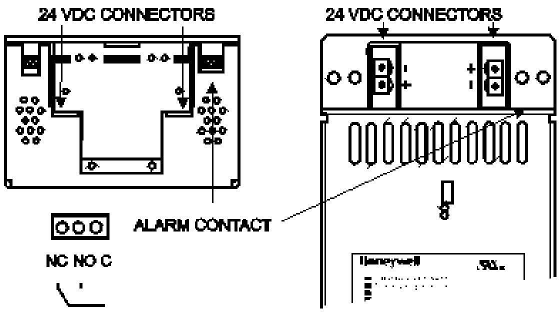
Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.
  A cable is included to connect the PSU to the mains.
- The DC output uses 2 internally mounted male output connectors, type Phoenix PCV6-16/2-G1F-10,16 with locking nuts.
  A dual cable set is included to transfer the load to the main power rail. For more information see “MB-0001” on page 783.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

Figure 87 on page 154 shows the connections and connector lay-out on the output side of the PSU-UNI2450U.

Figure 87 Connections on the output side of the PSU-UNI2450U[1]



1 Note that both 24 Vdc connectors are wired in parallel; there is no separation diode inbetween.

Table 27 on page 154 shows the recommended wire sizes for the power supply's input and output wiring.

Table 27 Recommended wire sizes for the PSU-UNI2450U power supply

INPUT	OUTPUT	
110 –240 Vac	**25 Vdc**	**Voltage drop (with dual output cable, length 1.8 m)**
2.5 mm² (AWG 14)	2 x 2 x 8.3 mm² (AWG 8)	192 mV/m at 48 A

Attention:

For installation in ATEX and IECEx systems the metal housing of the power supply unit (PSU) must be connected to ground via an external ground connection.

The ground wire must be connected to one of the four mounting screws of the PSU. Refer to Figure 82 on page 149.

Technical data

The FC-PSU-UNI2450U power supply unit has the following specifications:

General	Type numbers[1] :	FC-PSU-UNI2450U V1.0
	Approvals:	CE, TUV, UL, CSA, CID2
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–5°C—+70°C (23°F—+158°F) (see Figure 86 on page 153 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	25 Vdc or 28 Vdc; dual overvoltage protection
	Ripple and noise:	< 40 mVpp
	Output current (25 Vdc):	48 A at –5°C—+50°C (23°F—+122°F)
	Output current (28 Vdc):	43 A at –5°C—+50°C (23°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 86 on page 153 for derating curve)
	Hold-up time:	100 ms at full load
	Output voltage setting:	25 Vdc
	Efficiency at 230 Vac:	>87%
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	500 Vdc

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	2 x Phoenix PCV6-16/2-G1F-10,16 with locking screws
	cable connector	Phoenix PC 16/2-STF-10,16
	• min. wire size	0.75 mm^2
	• max. wire size	16 mm^2
	• strip length	12 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 22 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 27 V (30 V for 28 V mode) in case of malfunction of the normal regulation.

1 FC-type modules are conformal coated modules. Modules that are not conformal coated do not have the prefix FC.

The FA-PSU-UNI2450U power supply unit has the following specifications:

General	Type numbers [1]:	FA-PSU-UNI2450U V1.0 [2]
	Approvals:	CE, TUV, CSA, UL, ATEX, IECEx Ex signature: II 3G nA nC IIC T4 ATEX COC No.: EPS 10 ATEX 1 271 X IECEx COC No: IEC Ex LCI 10.0031 U
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–40°C—+70°C (–40°F—+158°F) (see Figure 86 on page 153 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	25 Vdc or 28 Vdc; dual overvoltage protection
	Ripple and noise:	< 40 mVpp
	Output current (25 Vdc):	48 A at –40°C—+50°C (–40°F—+122°F)
	Output current (28 Vdc):	43 A at –40°C—+50°C (–40°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 86 on page 153 for derating curve)
	Hold-up time:	100 ms at full load
	Output voltage setting:	25 Vdc
	Efficiency at 230 Vac:	>87%
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	500 Vdc

Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	2 x Phoenix PCV6-16/2-G1F-10,16 with locking screws
	cable connector	Phoenix PC 16/2-STF-10,16
	• min. wire size	0.75 mm^2
	• max. wire size	16 mm^2
	• strip length	12 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 22 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 27 V (30 V for 28 V mode) in case of malfunction of the normal regulation.

1 FA-type modules can be used to connect to devices in explosive atmospheres, conform to the applicable ATEX / IECEx guidelines.

2 In case the FA-PSU-UNI2450U is applied for ATEX / IECEx certified projects, the end user shall ensure that it is placed in an IP54 compliant enclosure.

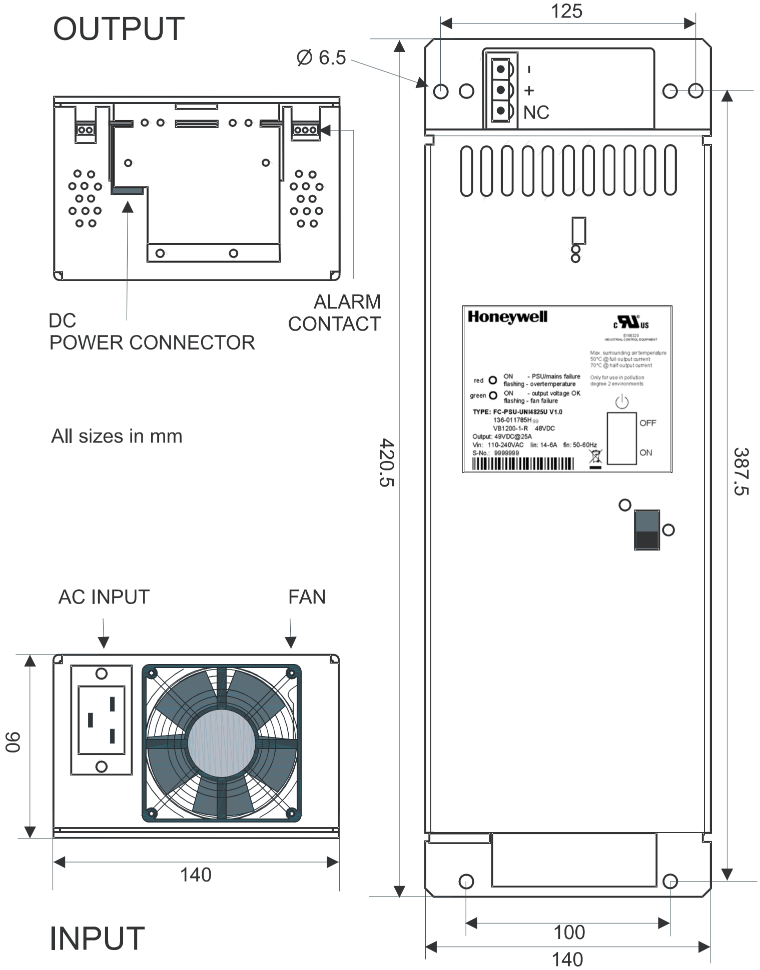
PSU-UNI4825U

48 Vdc Power supply (1200 W) – UL508 approved

Description

The PSU-UNI4825U power supply is a UL approved switched-mode DC power supply with a high efficiency (>87% at 230 Vac). It accepts a wide range of input voltages to provide 48 Vdc and 25 A output.

Figure 88 Top, bottom and front view of the PSU-UNI4825U power supply



Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- 100 ms holdup time
- Under-voltage alarm
- an output diode for parallel operation
- Optimum protection against continuous overload and short-circuiting.

The LEDs on the front panel indicate the following status:

green LED	on	PSU in operation; output OK
	off	PSU swithed off
	flashing	fan does not reach required speed
red LED	on	PSU/MAINS failure, or in stand-by mode
	off	no failure
	flashing	temperature too high

Hardware control features

The PSU-UNI4825U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

Power switch

Attention:

Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI4825U before you disconnect it.

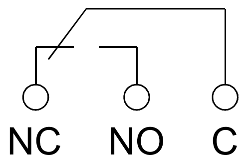
With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

Alarm contact

The PSU-UNI4825U has an alarm contact used for voltage monitoring.

Figure 89 on page 161 shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 44Vdc.

Figure 89 Alarm contact state with output voltage above 44 Vdc



Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see Figure 90 on page 162).

Notes:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

Figure 90 Vertical mounting of the PSU-UNI4825U power supply

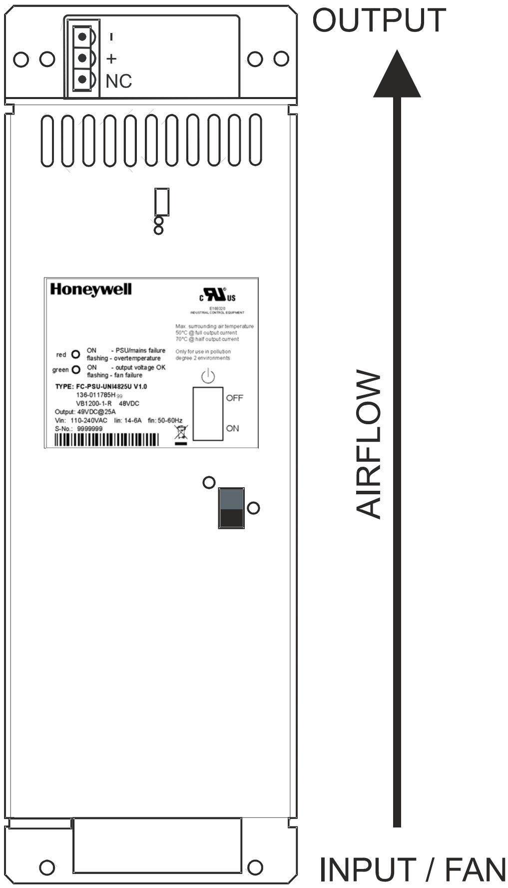
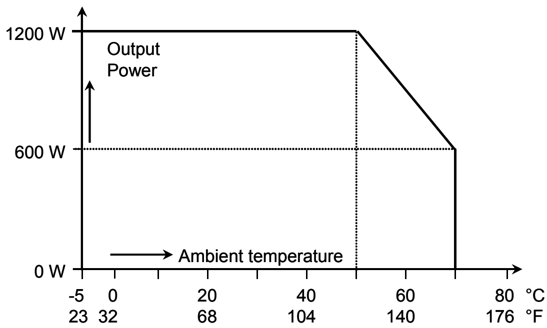


Figure 91 on page 163 shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

Figure 91 Derating curve[1] for the PSU-UNI4825U power supply.



1 Operation outside these perimeters may cause a temporary PSU shut-down.

Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.
  A cable is included to connect the PSU to the mains.
- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

Figure 92 on page 163 shows the connections and connector lay-out on the output side of the PSU-UNI4825U.

Figure 92 Connections on the output side of the PSU-UNI4825U

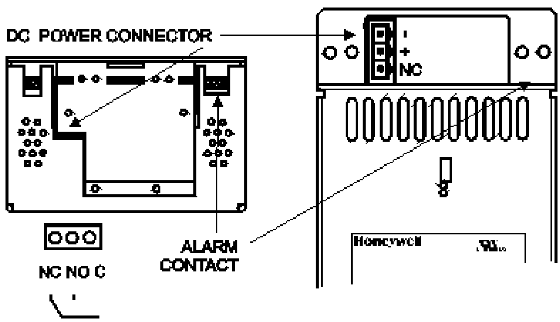


Table 28 on page 164 shows the recommended wire sizes for the power supply's input and output wiring.

Table 28 Recommended wire sizes for the PSU-UNI4825U power supply

INPUT	**OUTPUT**	
110 –240 Vac	**48 Vdc**	**Voltage drop (with output cable, length 1.8 m)**
2.5 mm² (AWG 14)	1 x 8.3 mm² (AWG 8)	200 mV/m at 25A

Technical data

The PSU-UNI4825U power supply unit has the following specifications:

General	Type numbers[1] :	FC-PSU-UNI4825U V1.0
	Approvals:	CE, TUV, UL508, CSA
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–5°C—+70°C (23°F—+158°F) (see Figure 91 on page 163 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	48 Vdc; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (48 Vdc):	25 A at –5°C—+50°C (23°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 91 on page 163 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	48 Vdc
	Efficiency at 230 Vac:	>87%

Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 Vdc
Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• min. wire size	0.2 mm^2
	• max. wire size	6 mm^2
	• strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 44 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 54 V in case of malfunction of the normal regulation.

1 FC-type modules are conformal coated modules. Modules that are not conformal coated do not have the prefix FC.

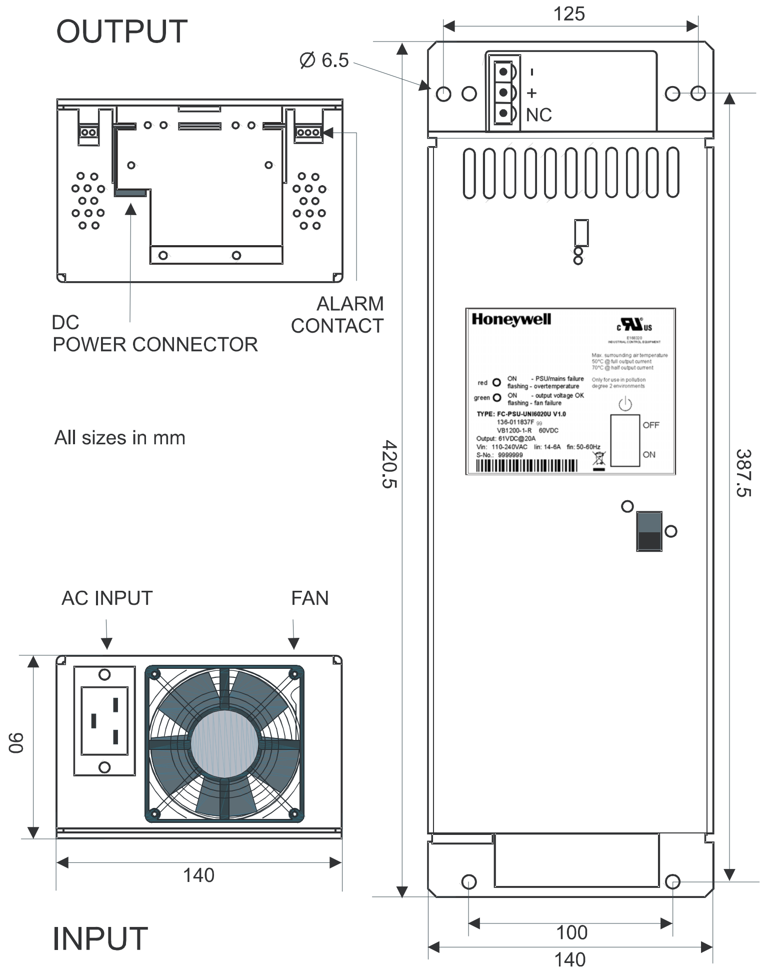
PSU-UNI6020U

60 Vdc Power supply (1200 W) – UL508 approved

Description

The PSU-UNI6020U power supply is a UL approved switched-mode DC power supply with a high efficiency (>87% at 230 Vac). It accepts a wide range of input voltages to provide 60 Vdc and 20 A output.

Figure 93 Top, bottom and front view of the PSU-UNI6020U power supply



Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- 100 ms holdup time
- Under-voltage alarm
- an output diode for parallel operation
- Optimum protection against continuous overload and short-circuiting.

The LEDs on the front panel indicate the following status:

green LED	on	PSU in operation; output OK
	off	PSU swithed off
	flashing	fan does not reach required speed
red LED	on	PSU/MAINS failure, or in stand-by mode
	off	no failure
	flashing	temperature too high

Hardware control features

The PSU-UNI6020U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

Power switch

Attention:

Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI6020U before you disconnect it.

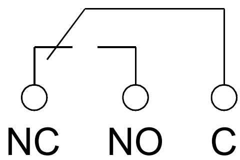
With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

Alarm contact

The PSU-UNI6020U has an alarm contact used for voltage monitoring.

Figure 94 on page 168 shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 54Vdc.

Figure 94 Alarm contact state with output voltage above 54 Vdc



Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see Figure 95 on page 169).

Notes:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

Figure 95 Vertical mounting of the PSU-UNI6020U power supply

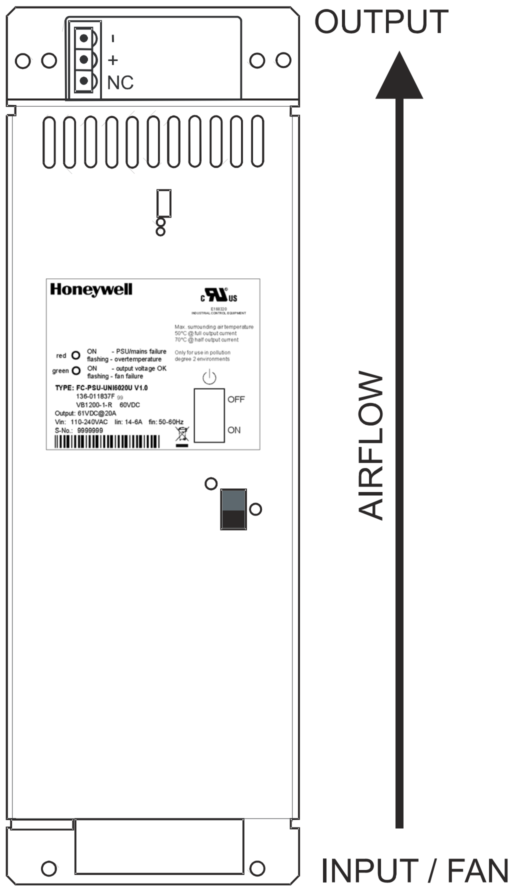
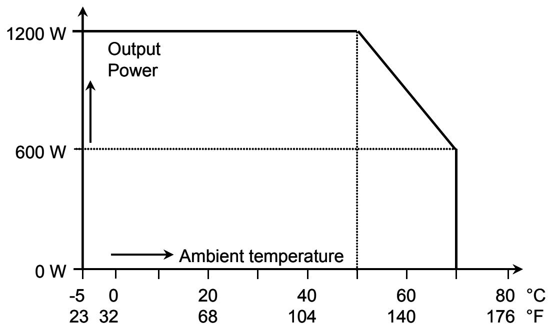


Figure 96 on page 170 shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

Figure 96 Derating curve[1] for the PSU-UNI6020U power supply.



1 Operation outside these perimeters may cause a temporary PSU shut-down.

Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.
  A cable is included to connect the PSU to the mains.
- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

Figure 97 on page 170 shows the connections and connector lay-out on the output side of the PSU-UNI6020U.

Figure 97 Connections on the output side of the PSU-UNI6020U

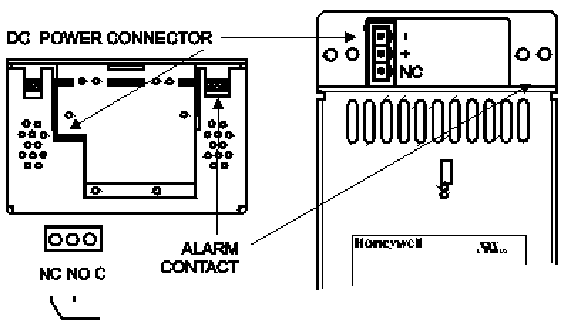


Table 29 on page 171 shows the recommended wire sizes for the power supply's input and output wiring.

Table 29 Recommended wire sizes for the PSU-UNI6020U power supply

INPUT	**OUTPUT**	
110 –240 Vac	**60 Vdc**	**Voltage drop (with output cable, length 1.8 m)**
2.5 mm² (AWG 14)	1 x 8.3 mm² (AWG 8)	160 mV/m at 20 A

Technical data

The PSU-UNI6020U power supply unit has the following specifications:

General	Type numbers[1] :	FC-PSU-UNI6020U V1.0
	Approvals:	CE, TUV, UL508, CSA
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – including the cable set
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–5°C—+70°C (23°F—+158°F) (see Figure 96 on page 170 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	60 Vdc; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (60 Vdc):	20 A at –5°C—+50°C (23°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 96 on page 170 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	60 Vdc
	Efficiency at 230 Vac:	>87%

Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 Vdc
Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• min. wire size	0.2 mm^2
	• max. wire size	6 mm^2
	• strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 54 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 70 V in case of malfunction of the normal regulation.

1 FC-type modules are conformal coated modules. Modules that are not conformal coated do not have the prefix FC.

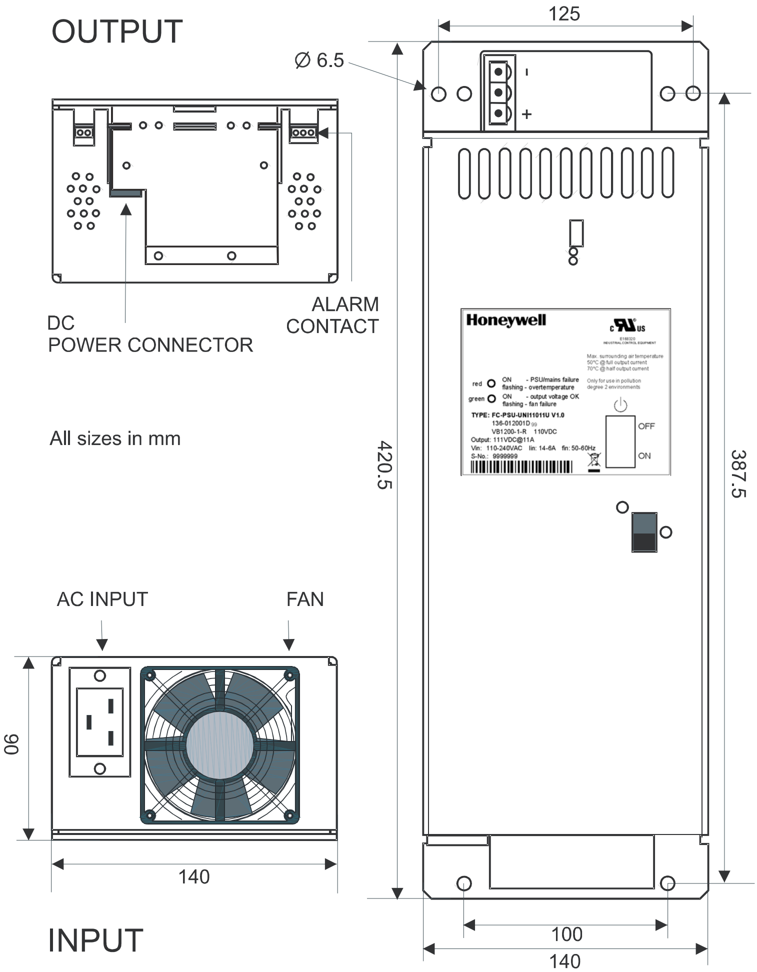
PSU-UNI11011U

110 Vdc Power supply (1200 W) – UL508 approved

Description

The PSU-UNI11011U power supply is a UL approved switched-mode DC power supply with a high efficiency (>87% at 230 Vac). It accepts a wide range of input voltages to provide 111 Vdc and 11 A output.

Figure 98 Top, bottom and front view of the PSU-UNI11011U power supply



Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- 100 ms holdup time
- Under-voltage alarm
- an output diode for parallel operation
- Optimum protection against continuous overload and short-circuiting.

The LEDs on the front panel indicate the following status:

green LED	on	PSU in operation; output OK
	off	PSU swithed off
	flashing	fan does not reach required speed
red LED	on	PSU/MAINS failure, or in stand-by mode
	off	no failure
	flashing	temperature too high

Hardware control features

The PSU-UNI11011U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

Power switch

Attention:

Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI11011U before you disconnect it.

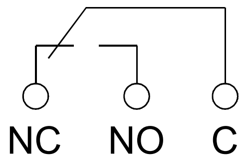
With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

Alarm contact

The PSU-UNI11011U has an alarm contact used for voltage monitoring.

Figure 99 on page 175 shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 100Vdc.

Figure 99 Alarm contact state with output voltage above 100Vdc



Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see Figure 100 on page 176).

Notes:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

Figure 100 Vertical mounting of the PSU-UNI11011U power supply

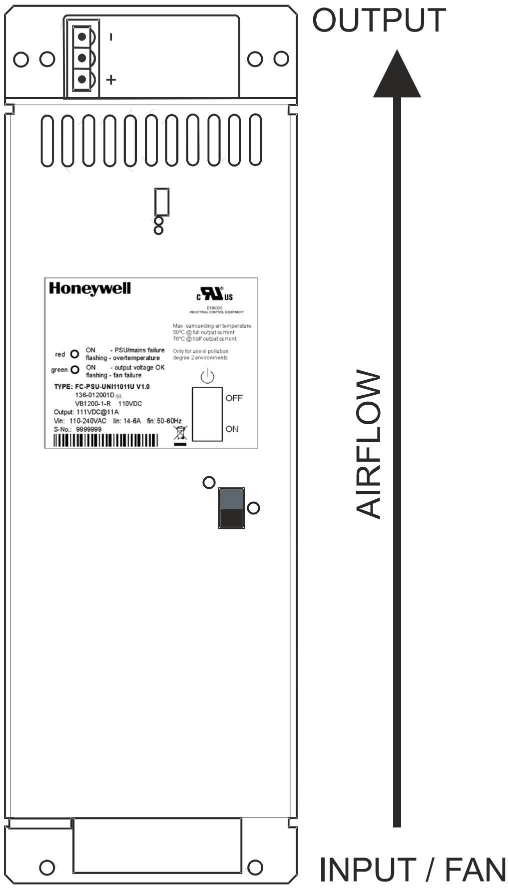
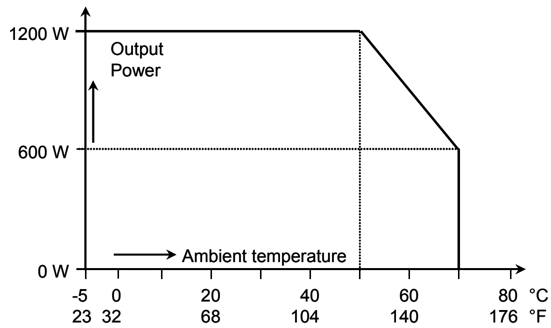


Figure 101 on page 177 shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

Figure 101 Derating curve[1] for the PSU-UNI11011U power supply.



1 Operation outside these perimeters may cause a temporary PSU shut-down.

Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.
  A cable is included to connect the PSU to the mains.
- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

Figure 102 on page 177 shows the connections and connector lay-out on the output side of the PSU-UNI11011U.

Figure 102 Connections on the output side of the PSU-UNI11011U

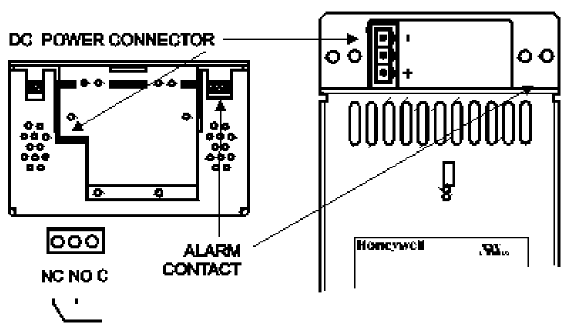


Table 30 on page 178 shows the recommended wire sizes for the power supply's input and output wiring.

Table 30 Recommended wire sizes for the PSU-UNI11011U power supply

INPUT	OUTPUT	
110 –240 Vac	**111 Vdc**	**Voltage drop (with output cable, length 1.8 m)**
2.5 mm² (AWG 14)	1 x 8.3 mm² (AWG 8)	88 mV/m at 11A

Technical data

The PSU-UNI11011U power supply unit has the following specifications:

General	Type numbers[1] :	FC-PSU-UNI11011U V1.0
	Approvals:	CE, TUV, UL508, CSA
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – cable set included
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–5°C—+70°C (23°F—+158°F) (see Figure 101 on page 177 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	111 Vdc; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (111 Vdc):	11 A at –5°C—+50°C (23°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 101 on page 177 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	111 Vdc
	Efficiency at 230 Vac:	>87%

Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 Vdc
Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• min. wire size	0.2 mm^2
	• max. wire size	6 mm^2
	• strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 99 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 120 V in case of malfunction of the normal regulation.

1 FC-type modules are conformal coated modules. Modules that are not conformal coated do not have the prefix FC.

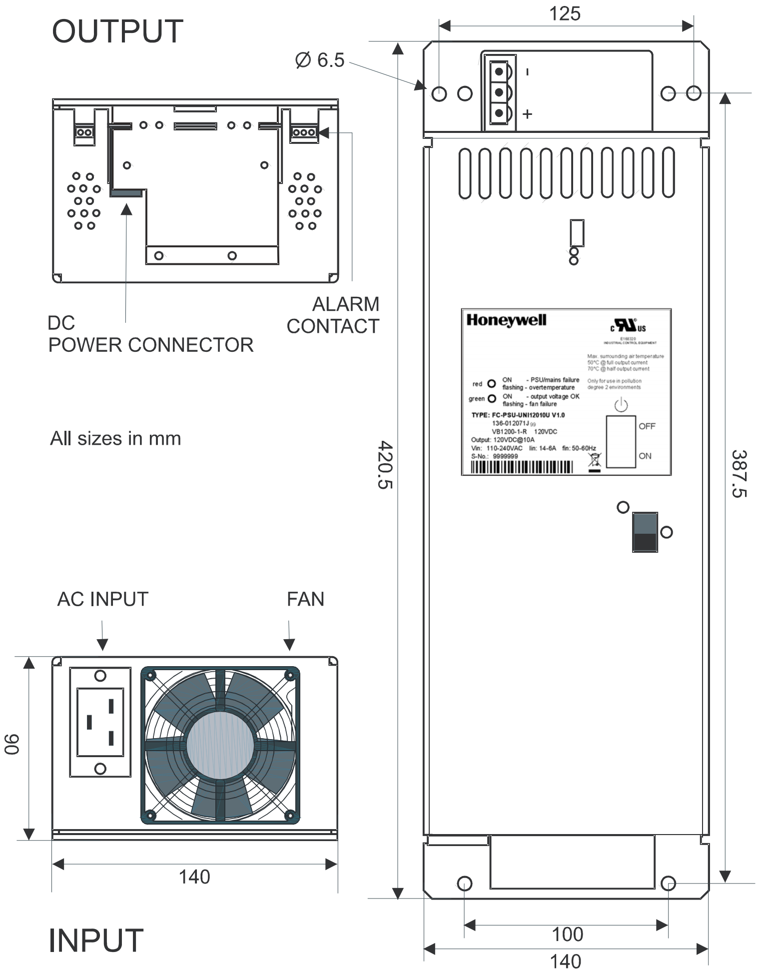
PSU-UNI12010U

120 Vdc Power supply (1200 W) – UL508 approved

Description

The PSU-UNI12010U power supply is a UL approved switched-mode DC power supply with a high efficiency (>87% at 230 Vac). It accepts a wide range of input voltages to provide 120 Vdc and 10 A output.

Figure 103 Top, bottom and front view of the PSU-UNI12010U power supply



Main features

The units main features include:

- Dual built-in over-voltage protection, to comply with the functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- ON/OFF switch on the power supply combined with isolated AC and DC power connectors enable on-line replacement of the unit in a live system.
- A current limit feature, used to limit the maximum output power to 1200 W.
- 100 ms holdup time
- Under-voltage alarm
- an output diode for parallel operation
- Optimum protection against continuous overload and short-circuiting.

The LEDs on the front panel indicate the following status:

green LED	on	PSU in operation; output OK
	off	PSU swithed off
	flashing	fan does not reach required speed
red LED	on	PSU/MAINS failure, or in stand-by mode
	off	no failure
	flashing	temperature too high

Hardware control features

The PSU-UNI12010U power supply has the following hardware control features:

- Power switch
- An alarm contact.

Each of these features is discussed in more detail below.

Power switch

Attention:

Cycling of the power switch can cause permanent damage to the power supply. After you switch the unit OFF, wait at least 30 seconds before you switch it ON again.

The power switch is sunk into the frame to prevent accidental operation. It allows you to switch off the PSU-UNI12010U before you disconnect it.

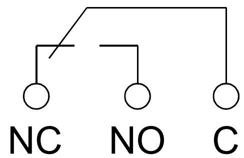
With the power switched off you can safely remove the AC and DC power cables without risk of sparks or spikes on the grid.

Alarm contact

The PSU-UNI12010U has an alarm contact used for voltage monitoring.

Figure 104 on page 182 shows the alarm contact with the relay energized, which means that the PSU is powered and the output voltage is above 100Vdc.

Figure 104 Alarm contact state with output voltage above 100Vdc



Installation

The unit can be mounted both vertically or horizontally.

Convection cooling works best when the unit is mounted vertically, with the power and fan input facing downwards (see Figure 105 on page 183).

Notes:

Vertical mounting is preferred for optimal cooling.

1. When the unit is mounted vertically at least 100mm (3.94 inch) free space is required above and below the unit.
2. When the unit is mounted horizontally at least 100mm (3.94 inch) free space is required around the unit.

Figure 105 Vertical mounting of the PSU-UNI12010U power supply

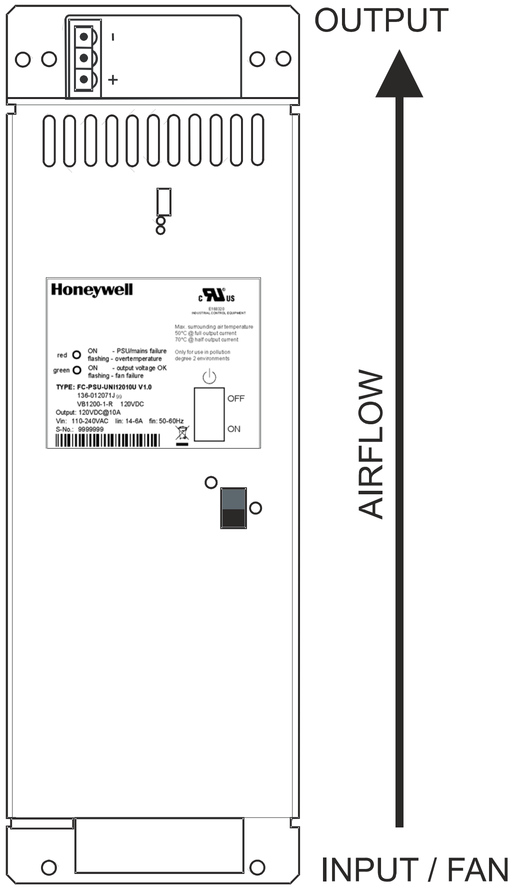
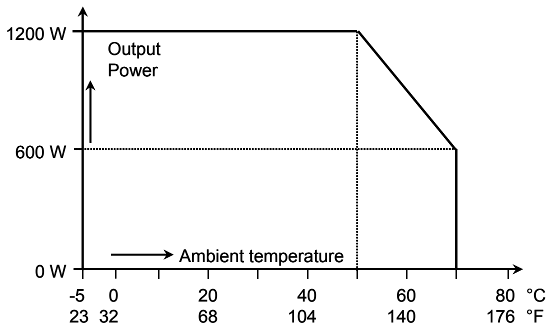


Figure 106 on page 184 shows that:

- The maximum PSU ambient temperature may not exceed 50°C (122°F) when operating at full load.
- When mounting vertically the maximum PSU ambient temperature may go up to 70°C (158°F) when operating at half load or less.

Figure 106 Derating curve[1] for the PSU-UNI12010U power supply.



1 Operation outside these perimeters may cause a temporary PSU shut-down.

Electrical connections

The following connection details apply to the power supply:

- The AC input uses a IEC60320 C20 inlet socket type with a retaining clip to hold the IEC60320 C19 power connector.
  A cable is included to connect the PSU to the mains.
- The DC output uses an internally mounted male output connector, type Phoenix PCV4/3 with locking nuts.
- The external alarm wires are mounted to a 3 pole female screw socket, make Phoenix, type MC 1,5/3-G-3,81. This connector is plugged into a male connector next to the power connectors.

Figure 107 on page 184 shows the connections and connector lay-out on the output side of the PSU-UNI12010U.

Figure 107 Connections on the output side of the PSU-UNI12010U

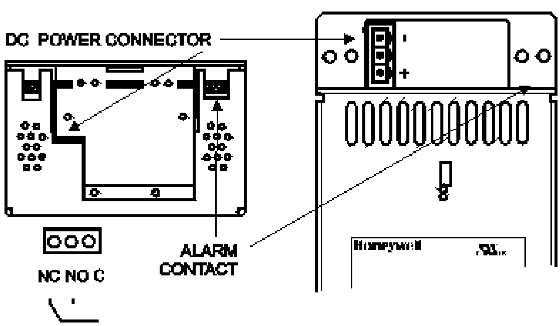


Table 31 on page 185 shows the recommended wire sizes for the power supply's input and output wiring.

Table 31 Recommended wire sizes for the PSU-UNI12010U power supply

INPUT	OUTPUT	
110 –240 Vac	**120 Vdc**	**Voltage drop (with output cable, length 1.8 m)**
2.5 mm² (AWG 14)	1 x 8.3 mm² (AWG 8)	88 mV/m at 10A

Technical data

The PSU-UNI12010U power supply unit has the following specifications:

General	Type numbers[1] :	FC-PSU-UNI12010U V1.0
	Approvals:	CE, TUV, UL508, CSA
Power	Power requirements:	110—240 Vac (operating limits: 93—253 Vac)
	Power consumption at no load:	13 W
	Input frequency range	47—63 Hz
Physical	Dimensions:	420.5 × 140 × 90 mm (W × H × D) 16.57 × 5.51 × 3.54 in (W × H × D)
	Weight:	5.7 kg (12.5 lb) – cable set included
Environment	Storage temperature:	–25°C—+85°C (–13°F—+185°F)
	Operating temperature:	–5°C—+70°C (23°F—+158°F) (see Figure 106 on page 184 for derating of output current as a function of ambient temperature)
Input	Inrush current:	< 15 A
Output	Output voltage:	120 Vdc; dual overvoltage protection
	Ripple and noise:	< 75mVpp
	Output current (111 Vdc):	10 A at –5°C—+50°C (23°F—+122°F)
	Derating output current:	Starting at 50°C (122°F): 30 W/°C (see Figure 106 on page 184 for derating curve)
	Hold-up time:	typically 100ms at 100% load
	Output voltage setting:	120 Vdc
	Efficiency at 230 Vac:	>87%

Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	1500 Vdc
Connectors	AC input:	IEC 60320 C20 inlet type socket, 16A with retaining clip
	DC output:	Phoenix PCV4/3-G-7,62 with locking screws
	cable connector	Phoenix PC 5/3-STF-7,62
	• min. wire size	0.2 mm^2
	• max. wire size	6 mm^2
	• strip length	10 mm
	Alarm contact:	3 pole Phoenix socket type MC 1,5/3-G-3,81
	cable connector	Phoenix MC 1,5/3-ST-3,81
	• min. wire size	0.14 mm^2
	• max. wire size	1.5 mm^2
	• strip length	7 mm
Alarm contact	Contact rating	100 mA / 30 V
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 108 Vdc.
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 132 V in case of malfunction of the normal regulation.

1 FC-type modules are conformal coated modules. Modules that are not conformal coated do not have the prefix FC.

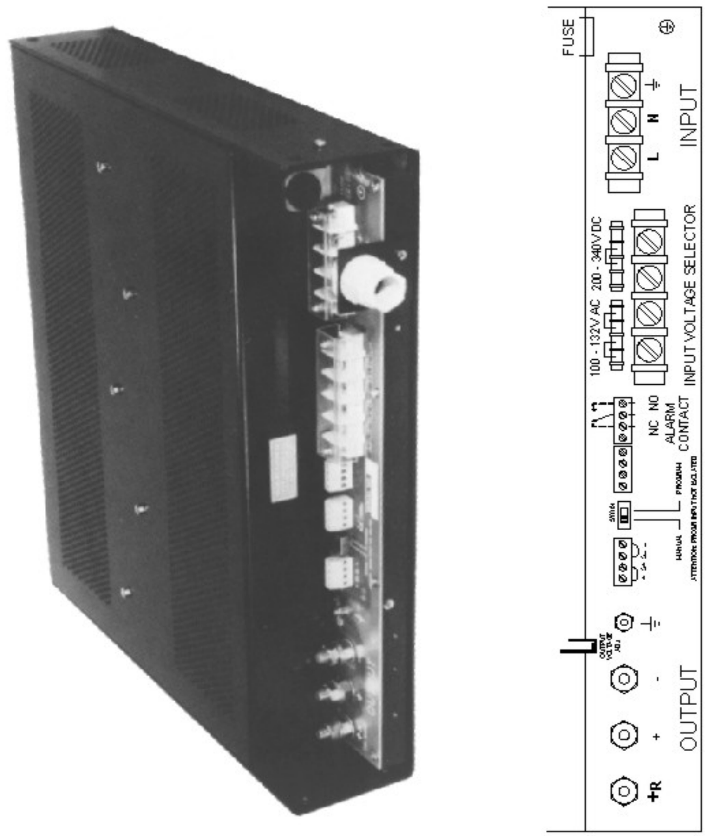
1200 S 24 P067

24 Vdc Power supply (45 A)

Description

The 1200 S 24 P067 power supply is a switched-mode DC power supply with a high efficiency (89% at 230 Vac). It accepts a wide range of input voltages to provide 24 Vdc, 45 A output.

Figure 108 Full view (left) and connections (right) of the 1200 S 24 P067 power supply



Main features

The units main features include:

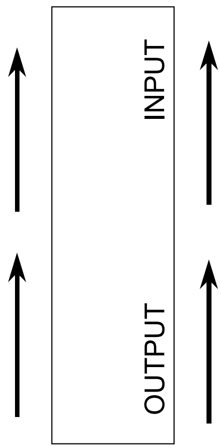
- Dual built-in over-voltage protection, to comply with the strict functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- Under-voltage alarm
- Redundant parallel operation (+R)
- Serial operation (for example to create 48 Vdc)
- Optimum protection against continuous overload and short-circuiting.

Green LEDs on the front and rear panels are lit up if the output voltage is present.

Installation

The 1200 S 24 P067 power supply can be mounted vertically or horizontally, although vertical mounting is recommended as it provides optimum cooling.

Figure 109 Vertical mounting of the 1200 S 24 P067 power supply



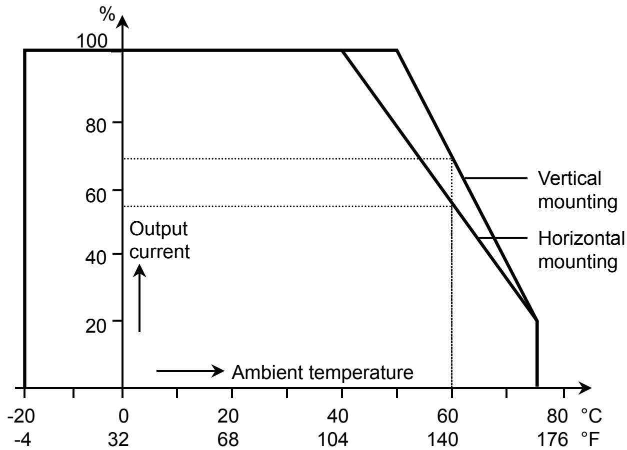
Convection cooling works best when the unit is mounted vertically, with the input connections facing upwards (see Figure 109 on page 188). The unit is constructed in such a way that the heat generated in the semiconductors and transformer flows through a thick aluminum profile to both covers, which act as heat sinks. It is therefore important that air can flow freely along both vertical sides of the power supply unit. This system of natural convection cooling was designed to bypass the need for forced ventilation, which has disadvantages as reliability, wear and tear, noise and dust filters. The unit is shipped with two H88 brackets for easy mounting.

Although vertical mounting is recommended, it is also possible to mount the unit horizontally, providing the maximum PSU ambient temperature does not exceed 40°C (104°F) at full load (see Figure 110 on page 189). When mounted in a 19" chassis, the unit must have sufficient free space for optimum cooling (min. 1 HE, 1U).

Note

If multiple power supplies need to be mounted above each other horizontally, it is recommended to use forced air cooling.

Figure 110 Derating curve (% of load vs. ambient temperature) for the 1200 S 24 P067 power supply



Recommended wire sizes

Table 32 on page 189 shows the recommended wire sizes for the power supply's input and output wiring.

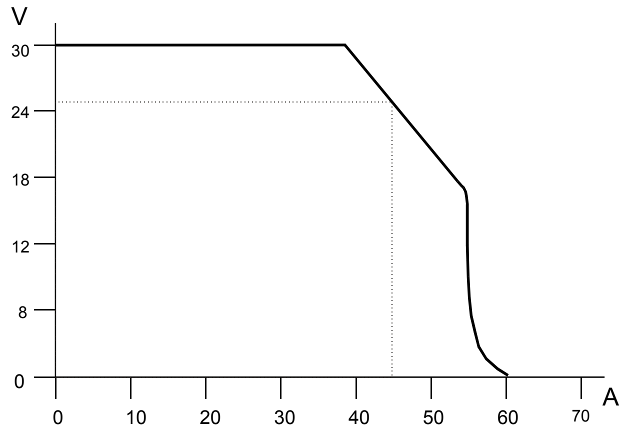
Table 32 Recommended wire sizes for the 1200 S 24 P067 power supply

INPUT		OUTPUT	
230 Vac	**115 Vac**	**24 Vdc**	**Voltage drop**
2.5 mm² (AWG 14)	4.0 mm² (AWG 12)	16 mm² (AWG 6)	50.4 mV/m at 45 A

Current limit

The unit has a current limit feature, which is used to limit the maximum output to 1100 W. Figure 111 on page 190 shows the current limit curve of the power supply.

Figure 111 Current limit of the 1200 S 24 P067 power supply



Hardware control features

The 1200 S 24 P067 power supply has a number of features which allow the unit to be tailored to specific applications (see Figure 108 on page 187).

These are:

- An output adjustment selector switch (SW101).
- An input voltage selector block.
- A sense block.
- An alarm contact.

Each of these features is discussed in more detail below.

Output adjustment selector switch (SW101)

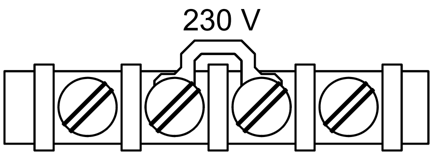
For Safety Manager applications, switch SW101 must be set to the **MANUAL** position, enabling adjustment of the output voltage with the potentiometer at the back (see Figure 108 on page 187).

Input voltage selector block

The power supply accepts a wide input voltage range. To set the input voltage range, use the input voltage selector block (see Figure 108 on page 187).

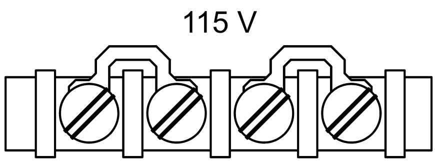
When the jumper is in the 230 V position (Figure 112 on page 191), the unit can be used for any line voltage between 200—264 Vac, 50—60 Hz (or 230—340 Vdc). Place a 15 A fuse in the fuse holder.

Figure 112 Selector block set at 230 V



When the two jumpers are in the 115 V position (see Figure 113 on page 1917), the unit can be used at any line voltage between 100 and 132 Vac 50/60 Hz. Place a 25 A fuse in the fuse holder.

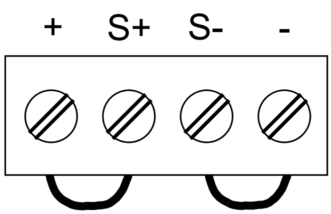
Figure 113 Selector block set at 115 V



Sense block

For Safety Manager applications (no remote sensing), S+ on the sense block (see Figure 114 on page 191) must be connected to + and S– to –. This is the default factory setting.

Figure 114 The sense block of the 1200 S 24 P067 power supply

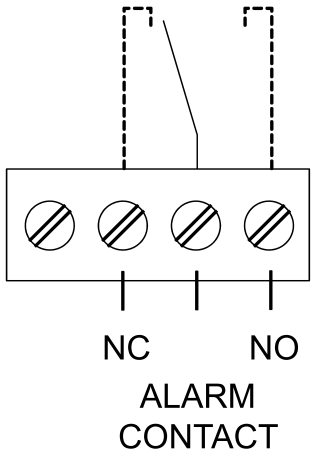


Alarm contact

The alarm contact is used for voltage monitoring.

Figure 115 on page 192 shows the alarm contact with the relay energized, which means the PSU is powered and output voltage is over 90% of the output voltage setting.

Figure 115 Relay contact alarm diagram of the 1200 S 24 P067 power supply



Technical data

The 1200 S 24 P067 power supply unit has the following specifications:

General	Type numbers:	1200 S 24 P067 1200 S 24-FM P067
	Approvals:	CE, UL, CSA, TUV, FM[1]
Power	Power requirements:	200—264 Vac, 50/60 Hz; 8.2 Arms, 15 AT fuse (see Figure 112 on page 191). 100—132 Vac, 50/60 Hz; 16.4 Arms, 25 AT fuse (see Figure 113 on page 191) 230—340 Vdc, 4.7 Adc, 15 AT fuse (see Figure 112 on page 191)
	Power consumption at no load:	< 40 W
	Acceptable frequency variability:	48—62 Hz
	Power factor:	0.72 at 230 Vac 0.80 at 115 Vac
Physical	Dimensions:	433 × 88 × 385 mm (W × H × D) 17.05 × 3.46 × 15.16 in (W × H × D)
	Weight:	11 kg (24.2 lb)
	Fuse dimensions:	32 × 6.3 mm (1.26 × 0.25 in)
Environment	Ambient temperatures:	
	• storage	–40°C—+85°C (–40°F—+185°F)
	• operating	–20°C—+75°C (–4°F—+167°F) (see Figure 110 on page 189 for derating of output current as a function of ambient temperature)
Input	Inrush current:	Limited by 39 Ω resistor (shorted after start-up)

Output	Output voltage:	24 Vdc with dual overvoltage protection
	Ripple and noise:	Max. 5 mVrms, 15 mVp-p
	Output current:	45 A at –20°C—+50°C (–4°F—+122°F) when mounted vertically 45 A at –20°C—+40°C (–4°F—+104°F) when mounted horizontally
	Derating of output current:	to 68% at 60°C (140°F) when mounted vertically to 54% at 60°C (140°F) when mounted horizontally (see Figure 110 on page 189 for derating curve)
	Hold-up time:	15 ms at 115 Vac or 220 Vac input and full load 30 ms at half load
	Output voltage setting:	25 Vdc (+R output)
	Efficiency at 230 Vac:	89% on + output; 87.5% on +R output
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 90% of the output voltage setting. Contact rating: 100 mA / 30 V
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 26.2 V in case of malfunction of the normal regulation.
	Serial operation:	up to 500 V total voltage
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	500 Vdc

1 FM approval applies only for the 1200 S 24-FM P067.

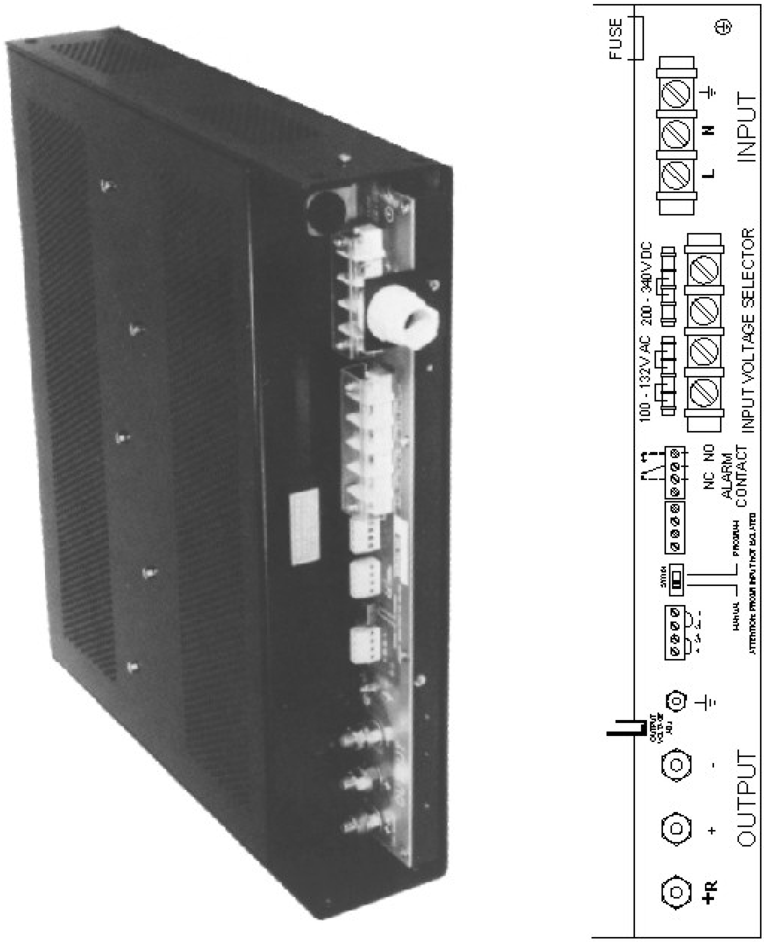
1200 S 48 P073

48 Vdc Power supply (22.5 A)

Description

The 1200 S 48 P067 power supply is a switched-mode DC power supply with a high efficiency (89% at 230 Vac). It accepts a wide range of input voltages to provide 48 Vdc, 22.5 A output.

Figure 116 Full view (left) and connections (right) of the 1200 S 48 P073 power supply



Main features

The units main features include:

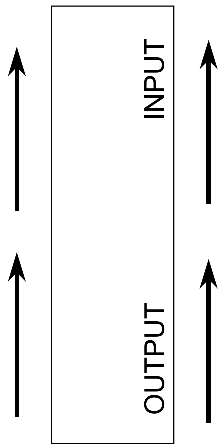
- Dual built-in over-voltage protection, to comply with the strict functional safety requirements of the DIN V 19250 and VDE V 0801 standards
- Under-voltage alarm
- Redundant parallel operation (+R)
- Optimum protection against continuous overload and short-circuiting.

Green LEDs on the front and rear panels are lit up if the output voltage is present.

Installation

The 1200 S 48 P073 power supply can be mounted vertically or horizontally, although vertical mounting is recommended as it provides optimum cooling.

Figure 117 Vertical mounting of the 1200 S 48 P073 power supply



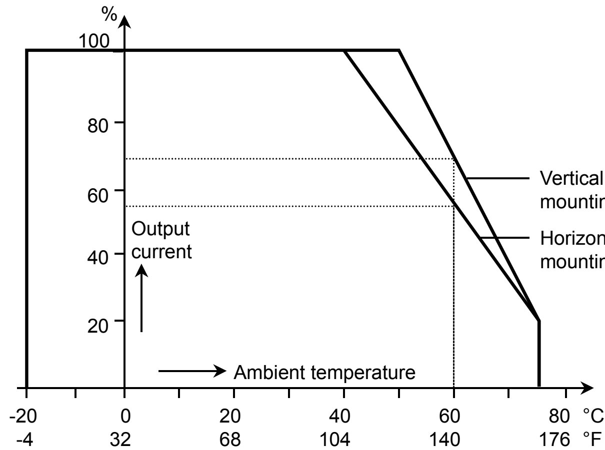
Convection cooling works best when the unit is mounted vertically, with the input connections facing upwards (see Figure 117 on page 196). The unit is constructed in such a way that the heat generated in the semiconductors and transformer flows through a thick aluminum profile to both covers, which act as heat sinks. It is therefore important that air can flow freely along both vertical sides of the power supply unit. This system of natural convection cooling was designed to bypass the need for forced ventilation, which has disadvantages as reliability, wear and tear, noise and dust filters. The unit is shipped with two H88 brackets for easy mounting.

Although vertical mounting is recommended, it is also possible to mount the unit horizontally, providing the maximum PSU ambient temperature does not exceed 40°C (104°F) at full load (see Figure 118 on page 197). When mounted in a 19" chassis, the unit must have sufficient free space for optimum cooling (min. 1 HE, 1U).

Note

If multiple power supplies need to be mounted above each other horizontally, it is recommended to use forced air cooling.

Figure 118 Derating curve (% of load vs. ambient temperature) for the 1200 S 48 P073 power supply



Recommended wire sizes

Table 33 on page 197 shows the recommended wire sizes for the power supply's input and output wiring.

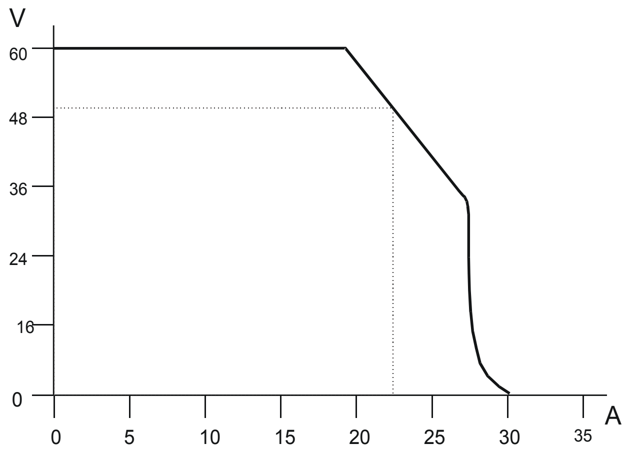
Table 33 Recommended wire sizes for the 1200 S 48 P073 power supply

INPUT		OUTPUT	
230 Vac	**115 Vac**	**48 Vdc**	**Voltage drop**
2.5 mm² (AWG 14)	4.0 mm² (AWG 12)	6 mm² (AWG 10)	69 mV/m at 22.5 A

Current limit

The unit has a current limit feature, which is used to limit the maximum output to 1100 W. Figure 119 on page 198 shows the current limit curve of the power supply.

Figure 119 Current limit of the 1200 S 48 P073 power supply



Hardware control features

The 1200 S 48 P073 power supply has a number of features which allow the unit to be tailored to specific applications (see Figure 116 on page 195).

These are:

- An output adjustment selector switch (SW101).
- An input voltage selector block.
- A sense block.
- An alarm contact.

Each of these features is discussed in more detail below.

Output adjustment selector switch (SW101)

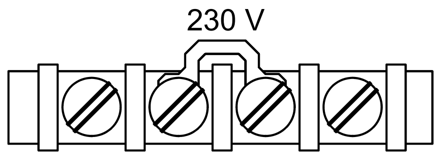
For Safety Manager applications, switch SW101 must be set to the **MANUAL** position, enabling adjustment of the output voltage with the potentiometer at the back (see Figure 116 on page 195).

Input voltage selector block

The power supply accepts a wide input voltage range. To set the input voltage range, use the input voltage selector block (see Figure 116 on page 195).

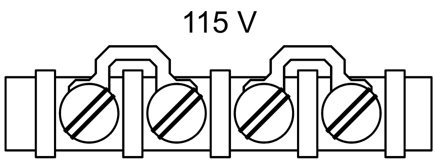
When the jumper is in the 230 V position (Figure 120 on page 199), the unit can be used for any line voltage between 200—264 Vac, 50—60 Hz (or 230—340 Vdc). Place a 15 A fuse in the fuse holder.

Figure 120 Selector block set at 230 V



When the two jumpers are in the 115 V position (see Figure 121 on page 1997), the unit can be used at any line voltage between 100 and 132 Vac 50/60 Hz. Place a 25 A fuse in the fuse holder.

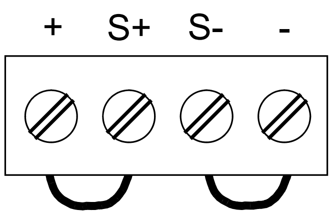
Figure 121 Selector block set at 115 V



Sense block

For Safety Manager applications (no remote sensing), S+ on the sense block (see Figure 122 on page 199) must be connected to + and S– to –. This is the default factory setting.

Figure 122 The sense block of the 1200 S 48 P073 power supply

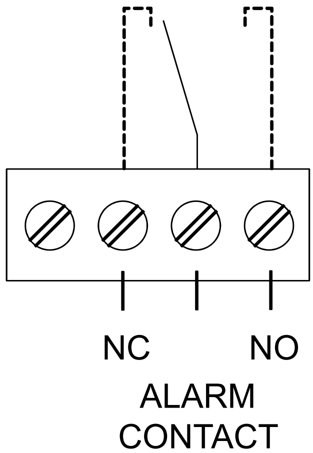


Alarm contact

The alarm contact is used for voltage monitoring.

Figure 123 on page 200 shows the alarm contact with the relay energized, which means the PSU is powered and output voltage is over 90% of the output voltage setting.

Figure 123 Relay contact alarm diagram of the 1200 S 48 P073 power supply



Technical data

The 1200 S 48 P073 power supply unit has the following specifications:

General	Type numbers:	1200 S 48 P073
	Approvals:	CE, UL, CSA, TUV
Power	Power requirements:	200—264 Vac, 50/60 Hz; 8.2 Arms, 15 AT fuse (see Figure 120 on page 199). 100—132 Vac, 50/60 Hz; 16.4 Arms, 25 AT fuse (see Figure 121 on page 199) 230—340 Vdc, 4.7 Adc, 15 AT fuse (see Figure 120 on page 199)
	Power consumption at no load:	< 40 W
	Acceptable frequency variability:	48—62 Hz
	Power factor:	0.72 at 230 Vac 0.80 at 115 Vac
Physical	Dimensions:	433 × 88 × 385 mm (W × H × D) 17.05 × 3.46 × 15.16 in (W × H × D)
	Weight:	11 kg (24.2 lb)
	Fuse dimensions:	32 × 6.3 mm (1.26 × 0.25 in)
Environment	Ambient temperatures:	
	• storage	–40°C—+85°C (–40°F—+185°F)
	• operating	–20°C—+75°C (–4°F—+167°F) (see Figure 118 on page 197 for derating of output current as a function of ambient temperature)
Input	Inrush current:	Limited by 39 Ω resistor (shorted after start-up)

Output	Output voltage:	48 Vdc with dual overvoltage protection
	Ripple and noise:	Max. 5 mVrms, 15 mVp-p
	Output current:	22.5 A at –20°C—+50°C (–4°F—+122°F) when mounted vertically 22.5A at –20°C—+40°C (–4°F—+104°F) when mounted horizontally
	Derating of output current:	to 68% at 60°C (140°F) when mounted vertically to 54% at 60°C (140°F) when mounted horizontally (see Figure 118 on page 197 for derating curve)
	Hold-up time:	15 ms at 115 Vac or 220 Vac input and full load 30 ms at half load
	Output voltage setting:	49 Vdc (`+R` output)
	Efficiency at 230 Vac:	89% on `+` output 88% on `+R` output
	Undervoltage alarm contact:	Relay de-energizes when output voltage drops below 90% of the output voltage setting. Contact rating: 100 mA / 30 V
	Voltage limit:	For safety, two independent regulation circuits limit the output voltage to approximately 55.1 V in case of malfunction of the normal regulation.
	Serial operation:	up to 500 V total voltage
Isolation	Input to output:	3750 Vrms (1 min.)
	Input to case:	2500 Vrms (1 min.)
	Output to case:	500 Vdc

FS-FEEDER-24R

24 Vdc Feeder unit redundant

Description

The 24 Vdc Feeder unit redundant (FS-FEEDER-24R) consists of a melamine plate on which a redundant feeder unit is installed.

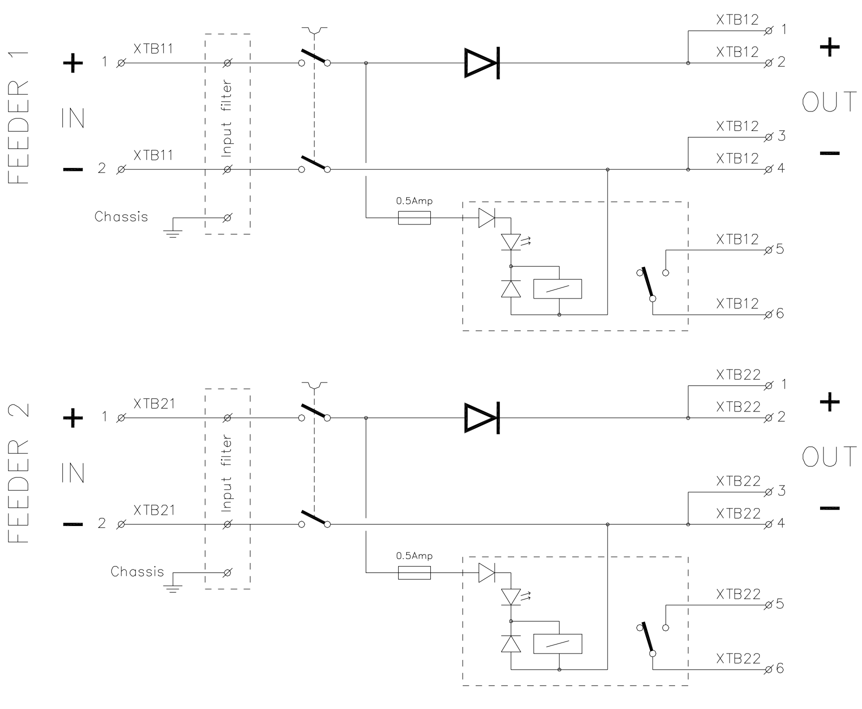
The 24 Vdc feeder unit is completely assembled and pre wired. Only cabling to the input and output terminals and readback contact need to be connected.

The complete 24 Vdc feeder unit is protected by removable perspex cover plates.

Wiring details

Figure 124 on page 203 shows the schematic wiring diagram for both feeders as they are installed on the 24 Vdc feeder unit redundant (FS-FEEDER-24R).

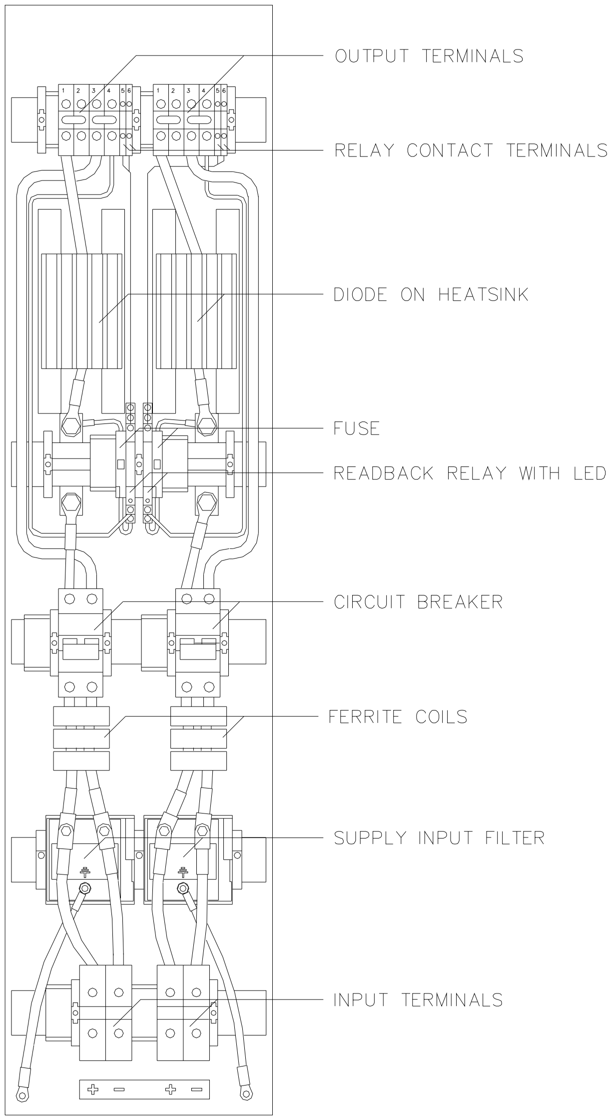
Figure 124 Schematic wiring diagram



Layout

Figure 125 on page 204 shows the layout of the 24 Vdc feeder unit FS-FEEDER-24R with the location of all components.

Figure 125 Layout of the 24 Vdc Feeder unit redundant



Input terminals

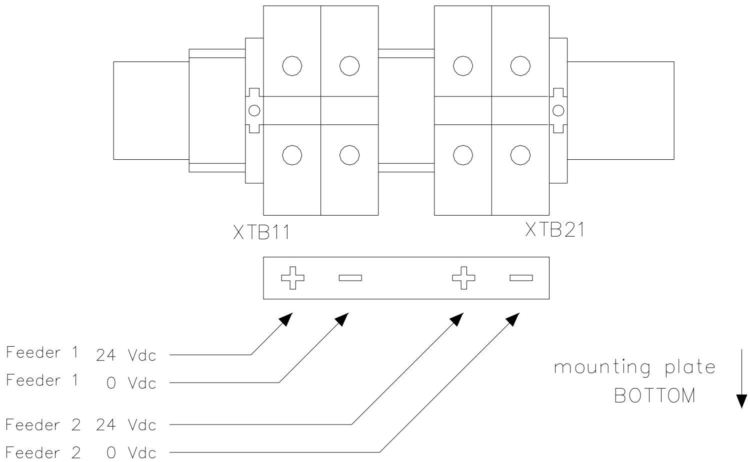
Note:

The maximum allowed wire size is 95 mm^2.

For each 24 Vdc input feeder 2 Weidmuller WDU 70N/35 terminals are mounted at the bottom of the redundant feeder unit.

Figure 126 on page 205 shows the 24 Vdc input terminal details.

Figure 126 24 Vdc input terminal details



Supply input filter

For each 24 Vdc input feeder a supply input filter (Honeywell SMS model FS-SIF-24) is installed. For more information see the respective data sheets.

Circuit breaker

Tip:

If desired it is possible to have the default circuit breaker replaced by an approved type with a *lower* rating.

This must be identified before hand by the cabinet integrator or the end-user.

For each 24 Vdc input feeder an ABB double pole circuit breaker is installed. The standard installed double pole circuit breaker is rated for 63 Amp.

Diode

For each 24 Vdc input feeder a diode with heat sink is installed.

Each diode:

- is capable of handling 130A throughput current (2.5kA peak current),
- can sustain a reverse voltage of 1.2 kV,
- has a forward voltage drop of ≤ 1.5V.

Output terminals

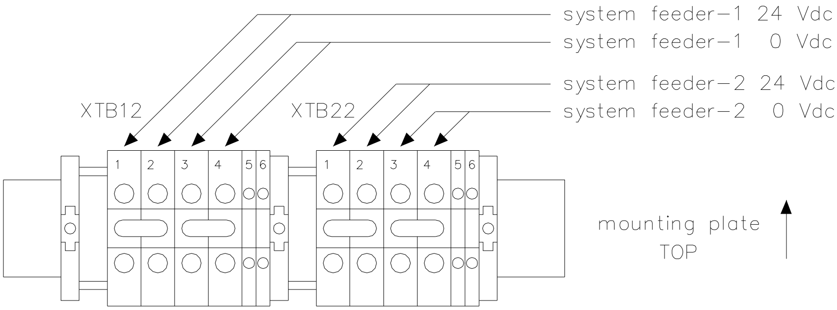
Note:

The maximum allowed wire size is 16 mm^2.

For each 24 Vdc output 2 Weidmuller WDU 16 terminals are mounted.

Figure 127 on page 206 shows the 24 Vdc output terminal details. *Terminal 3 is not to be used.* The shaded terminal blocks have a different function.

Figure 127 24 Vdc output terminal details

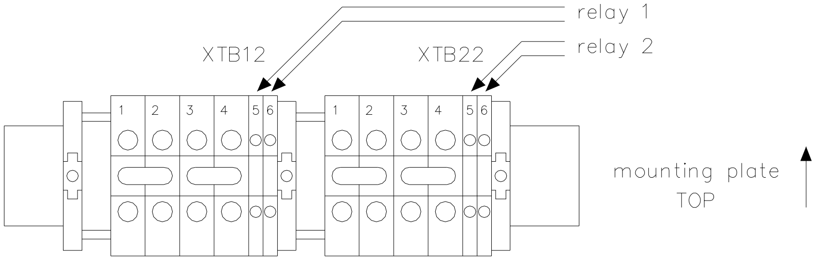


Readback relay terminals

For each 24 Vdc input feeder a readback contact is available to indicate the feeder status. Figure 128 on page 207 shows the readback contact terminal details.

- When 24 Vdc is supplied to the 24 Vdc input terminals, the (NO) contact will be closed. This contact is a potential free contact.
- Each relay has a green indication LED. When 24 Vdc is supplied to the feeder terminals, the LED will be on.
- The relays can be extracted from their terminal socket and be replaced with an identical spare part.

Figure 128 Readback contact terminal details



Fuse

A fused terminal is installed in the coil circuit to protect the readback relay. This fused terminal is equipped with a 0.5 Amp fuse slow blow.

Mounting details

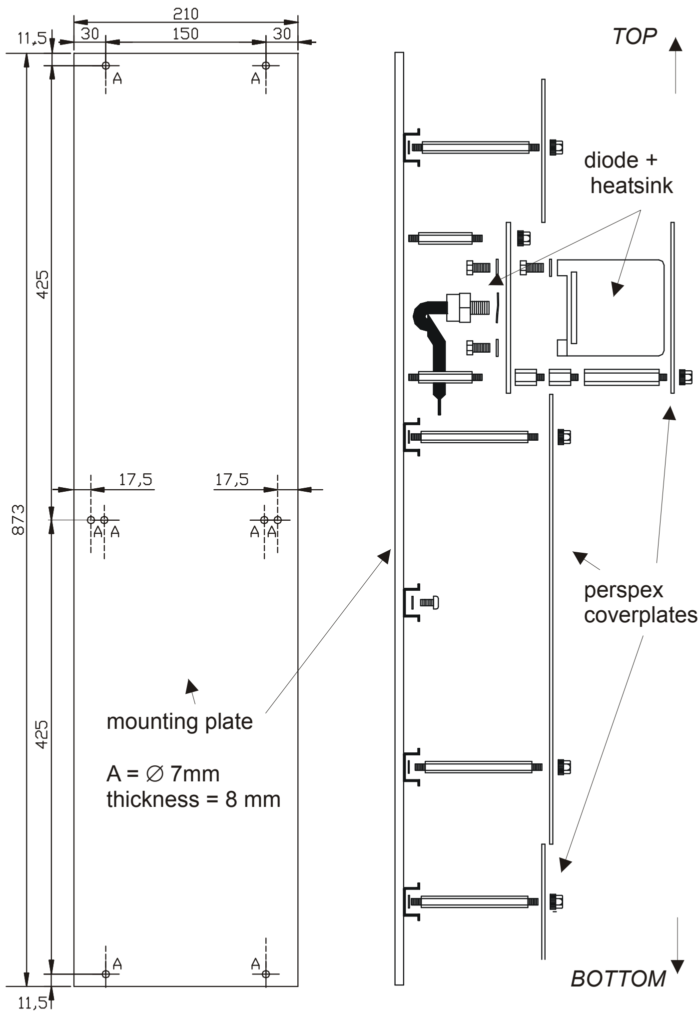
Note:

The 24 Vdc Feeder unit redundant (FS-FEEDER-24R) should be mounted in vertical position to ensure that the heat sink of the diode has sufficient airflow.

Figure 129 on page 208 left shows the measurements and the mounting hole locations of the of the 24 Vdc feeder unit (FS-FEEDER-24R).

Figure 129 on page 208 right shows the location of the perspex covers that can be (dis-)mounted for easy access to labels and terminals. The covers must be placed and locked with plastic moulded nuts after assembly of the unit.

Figure 129 Mounting plan and measurements of the FS-FEEDER-24R



Technical data

The FS-FEEDER-24R redundant power feeder unit has the following specifications:

General	Type number:	FS-FEEDER-24R V2.0 [1]
	Approvals:	CE
Input terminals	Make:	Weidmuller
	Type:	WDU 70N/35
	Maximum cable size:	95 mm^2 (AWG 3/0)
	Tightening torque, min:	10 Nm
Output terminals	Make:	Weidmuller
	Type:	WDU 16
	Maximum cable size:	16 mm^2 (AWG 6)
Fuse	Fuse rating:	0.5 A slow blow
	Measurements:	5 x 20 mm
Relay	Coil current:	6.6 mA at 24 Vdc
	Maximum switching power	250 Vac / 6 A
	Minimum switching power	12 V / 10 mA
	Terminal wire size	≥ 0.5 mm^2 (AWG 30) ≤ 4 mm^2 (AWG 12)
Diode	Peak reverse voltage:	1.2 kV
	Maximum continues current:	130 A
	Peak current:	2.5 kA
	Voltage drop:	≤ 1.5 V
Physical	Space requirements:	873 x 210 x 190 mm (H xW xD) 34.4 x 8.3 x 7.5 in (H xW xD)
	Weight:	8.8 kg (19.4 lb.)

1 V1.0 has a different output terminal configuration:
- terminal 1: system feeder 24 Vdc,
- terminal 2: system feeder 0 Vdc,
- terminals 11 and 14: relay contact.

FS-FEEDER-48R

48 Vdc Feeder unit redundant

Description

The 48 Vdc Feeder unit redundant (FS-FEEDER-48R) consists of a melamine plate on which a redundant feeder unit is installed.

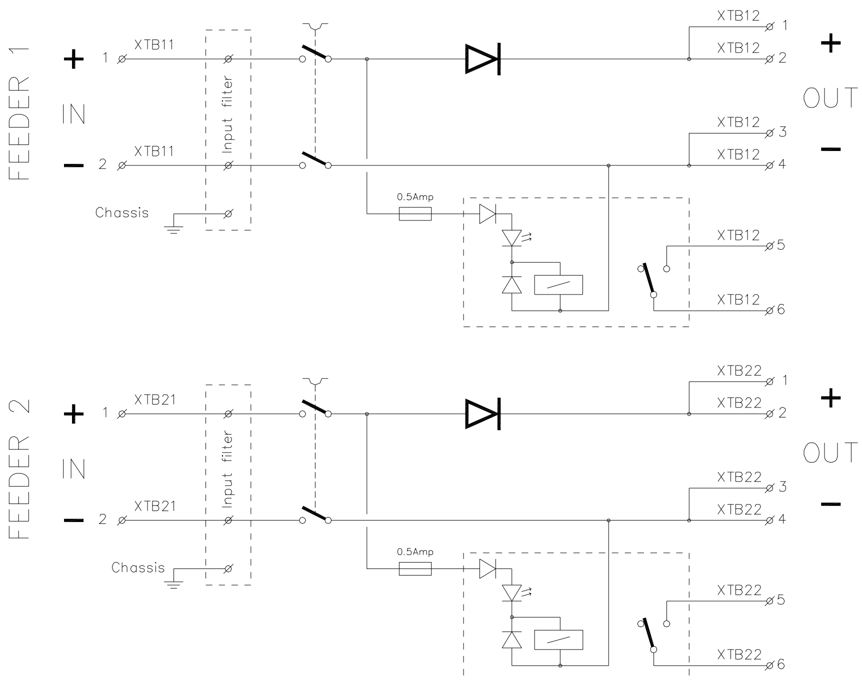
The 48 Vdc feeder unit is completely assembled and pre wired. Only cabling to the input and output terminals and readback contact need to be connected.

The complete 48 Vdc feeder unit is protected by removable perspex cover plates.

Wiring details

Figure 130 on page 210 shows the schematic wiring diagram for both feeders as they are installed on the 48 Vdc feeder unit redundant (FS-FEEDER-48R).

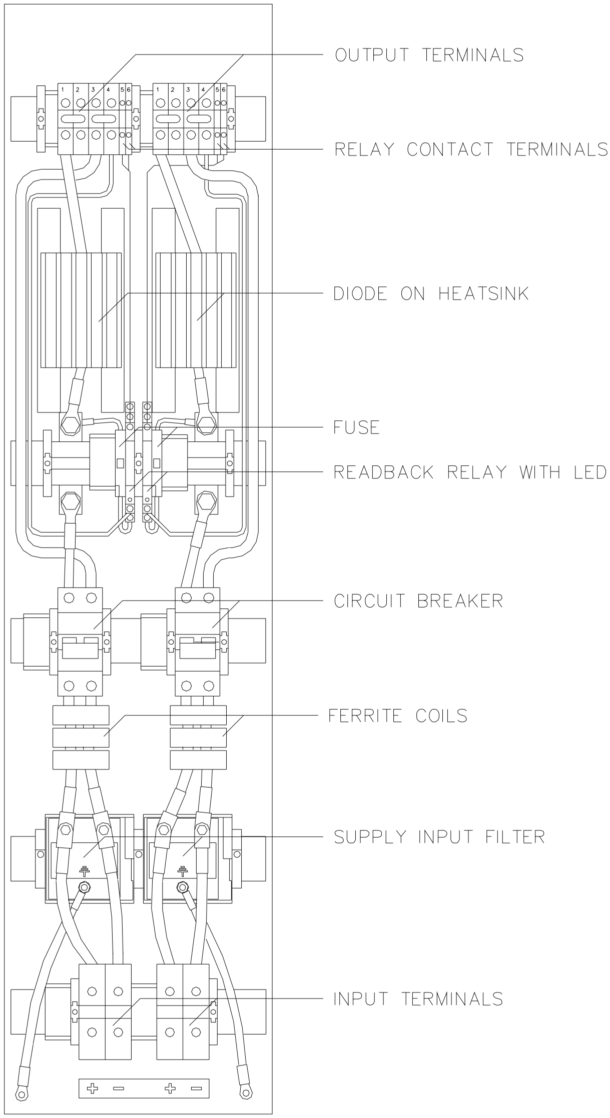
Figure 130 Schematic wiring diagram



Layout

Figure 131 on page 211 shows the layout of the 48 Vdc feeder unit FS-FEEDER-48R with the location of all components.

Figure 131 Layout of the 48 Vdc Feeder unit redundant



Input terminals

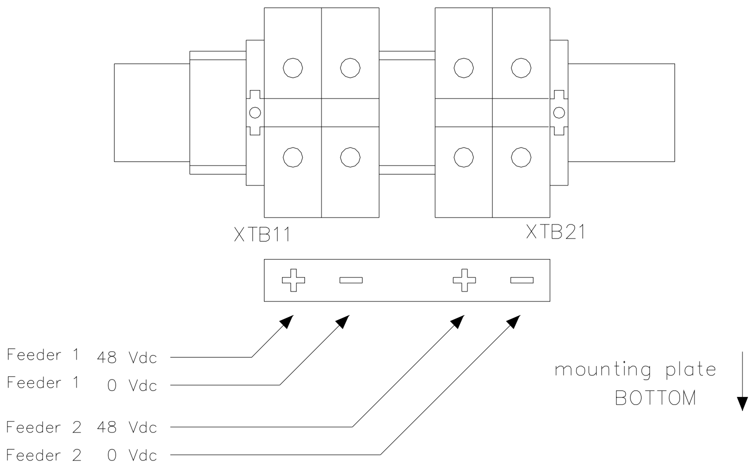
Note:

The maximum allowed wire size is 95 mm^2.

For each 48 Vdc input feeder 2 Weidmuller WDU 70N/35 terminals are mounted at the bottom of the redundant feeder unit.

Figure 132 on page 212 shows the 48 Vdc input terminal details.

Figure 132 48 Vdc input terminal details



Supply input filter

For each 48 Vdc input feeder a supply input filter (Honeywell SMS model FS-SIF-48) is installed. For more information see the respective data sheets.

Circuit breaker

Tip:

If desired it is possible to have the default circuit breaker replaced by an approved type with a *lower* rating.

This must be identified before hand by the cabinet integrator or the end-user.

For each 48 Vdc input feeder an ABB double pole circuit breaker is installed. The standard installed double pole circuit breaker is rated for 63 Amp.

Diode

For each 48 Vdc input feeder a diode with heat sink is installed.

Each diode:

- is capable of handling 130A throughput current (2.5kA peak current),
- can sustain a reverse voltage of 1.2 kV,
- has a forward voltage drop of ≤ 1.5V.

Output terminals

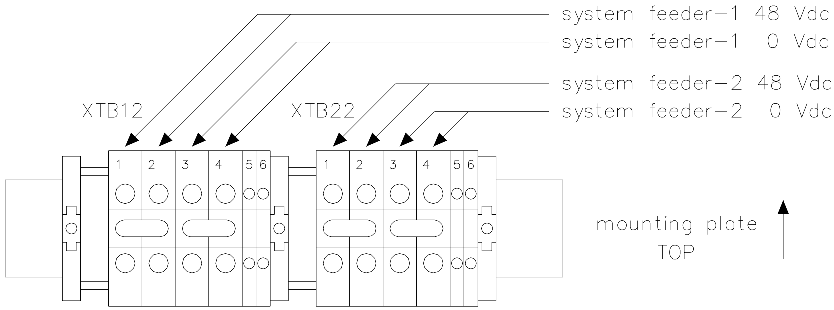
Note:

The maximum allowed wire size is 16 mm^2.

For each 48 Vdc output 2 Weidmuller WDU 16 terminals are mounted.

Figure 133 on page 213 shows the 48 Vdc output terminal details. *Terminal 3 is not to be used.* The shaded terminal blocks have a different function.

Figure 133 48 Vdc output terminal details

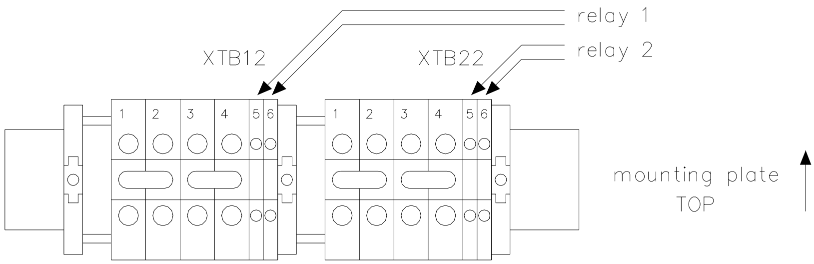


Readback relay terminals

For each 48 Vdc input feeder a readback contact is available to indicate the feeder status. Figure 134 on page 214 shows the readback contact terminal details.

- When 48 Vdc is supplied to the 48 Vdc input terminals, the (NO) contact will be closed. This contact is a potential free contact.
- Each relay has a green indication LED. When 48 Vdc is supplied to the feeder terminals, the LED will be on.
- The relays can be extracted from their terminal socket and be replaced with an identical spare part.

Figure 134 Readback contact terminal details



Fuse

A fused terminal is installed in the coil circuit to protect the readback relay. This fused terminal is equipped with a 0.5 Amp fuse slow blow.

Mounting details

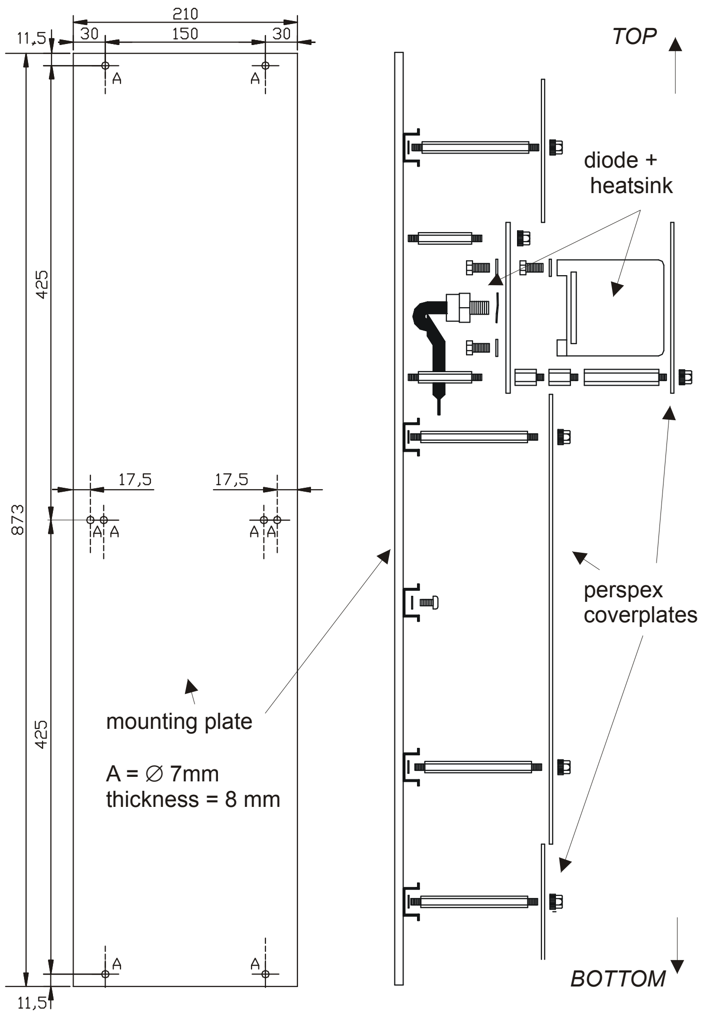
Note:

The 48 Vdc Feeder unit redundant (FS-FEEDER-48R) should be mounted in vertical position to ensure that the heat sink of the diode has sufficient airflow.

Figure 135 on page 215 left shows the measurements and the mounting hole locations of the of the 48 Vdc feeder unit (FS-FEEDER-48R).

Figure 135 on page 215 right shows the location of the perspex covers that can be (dis-)mounted for easy access to labels and terminals. The covers must be placed and locked with plastic moulded nuts after assembly of the unit.

Figure 135 Mounting plan and measurements of the FS-FEEDER-48R



Technical data

The FS-FEEDER-48R redundant power feeder unit has the following specifications:

General	Type number:	FS-FEEDER-48R V2.0 [1]
	Approvals:	CE
Input terminals	Make:	Weidmuller
	Type:	WDU 70N/35
	Maximum cable size:	95 mm^2 (AWG 3/0)
	Tightening torque, min:	10 Nm
Output terminals	Make:	Weidmuller
	Type:	WDU 16
	Maximum cable size:	16 mm^2 (AWG 6)
Fuse	Fuse rating:	0.5 A slow blow
	Measurements:	5 x 20 mm
Relay	Coil current:	4 mA at 48 Vdc
	Maximum switching power	250 Vac / 6 A
	Minimum switching power	12 V / 10 mA
	Terminal wire size	≥ 0.5 mm^2 (AWG 30) ≤ 4 mm^2 (AWG 12)
Diode	Peak reverse voltage:	1.2 kV
	Maximum continues current:	130 A
	Peak current:	2.5 kA
	Voltage drop:	≤ 1.5 V
Physical	Space requirements:	873 x 210 x 190 mm (HxWxD) 34.4 x 8.3 x 7.5 in (HxWxD)
	Weight:	8.8 kg (19.4 lb.)

1 V1.0 has a different output terminal configuration:
- terminal 1: system feeder 48 Vdc,
- terminal 2: system feeder 0 Vdc,
- terminals 11 and 14: relay contact.

RUSPSU-R

Redundant Power Supply assembly 24 Vdc, 12 A

Description

The RUSPSU-R is a power supply assembly providing a redundant 25Vdc, 12 A supply voltage (out of a 120Vac or 230Vac line power).

The RUSPSU-R consists of:

- one PSUTA-0001 (see “PSUTA-0001” on page 229)
- and two PSU-UNI2412 power supply units (see “PSUTA-0001” on page 229)

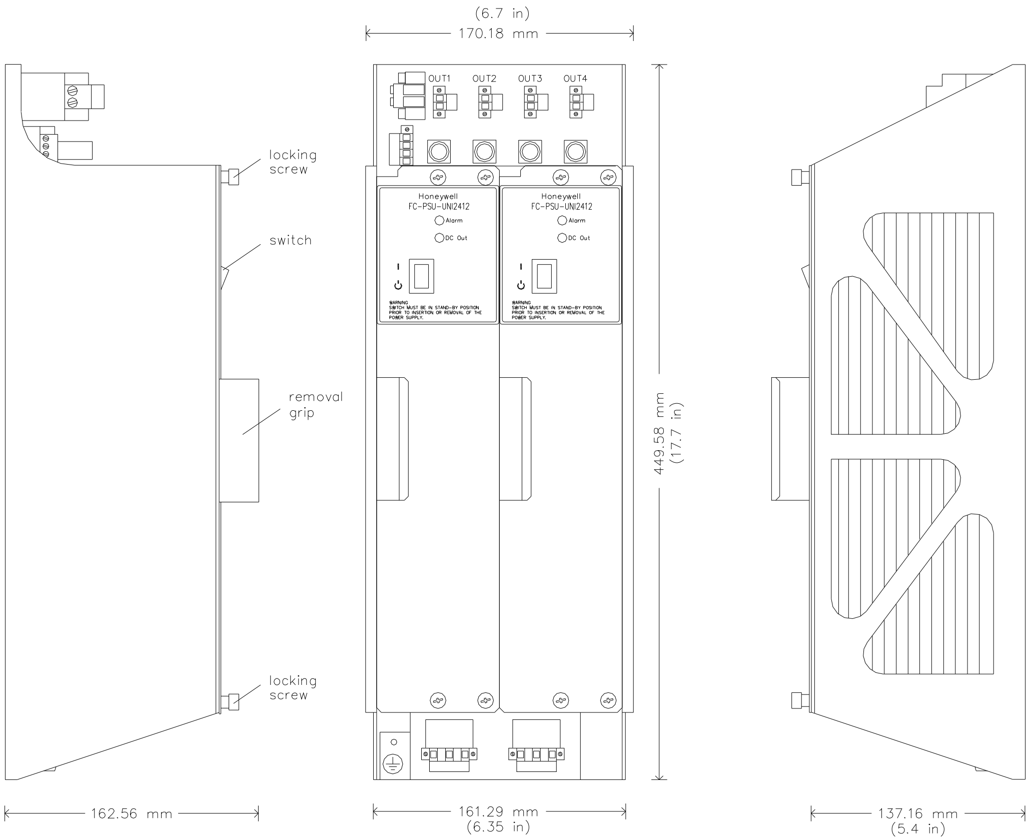
The RUSPSU-R is usable in SIL 3 applications.

Figure 136 on page 218 shows the physical appearance of the RUSPSU-R.

Warning:

The switch must be in stand-by position prior to insertion or removal of the power supply.

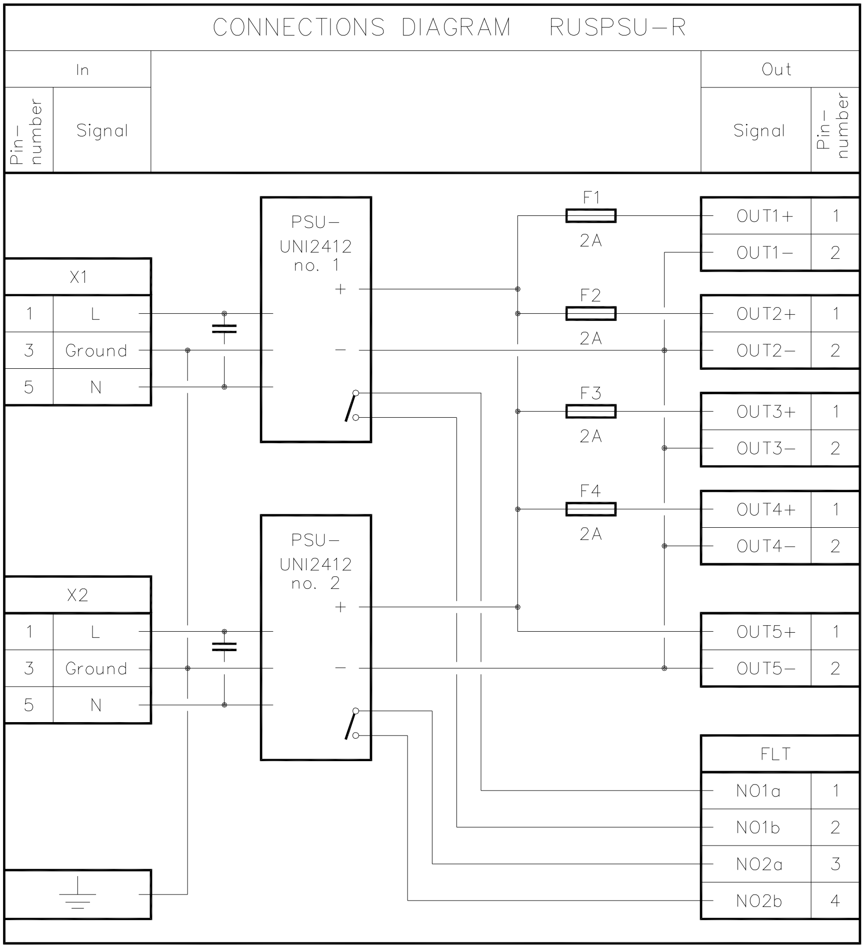
Figure 136 RUSPSU-R - mechanical layout



Connections

The connection diagram of the RUSPSU-R power supply assembly is as follows:

Figure 137 Connection diagram



Technical data

The RUSPSU-R power supply assembly has the following specifications:

General	Type number:	FC-RUSPSU-R
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV, IECEx pending
Power IN	Supply voltage:	102..132 Vac or 196 .. 253 Vac
	Frequency:	47 .. 63 Hz
	Connector name:	X1, X2
Power OUT	Output voltage:	25 Vdc nominal
	Output current:	0 .. 12 A (redundant)
	Connector name:	OUT1, OUT, OUT3, OUT4 (2 A fused)
	Connector name:	OUT5 (0 .. 12 A)
Alarm contact	Voltage	0 .. 30 Vac or Vdc
	Current:	0 .. 65 mA (non-inductive)
	Connector name:	FLT
Physical Data	Dimensions (H x W x D):	447.04 x 157.48 x 162.56 mm 17.6 x 6.2 x 6.4 in
	Weight:	8.6 kg 18.9 lbs

RUSPSU-S

Non-redundant Power Supply assembly 24 Vdc, 12 A

Description

The RUSPSU-S is a power supply assembly providing a 25Vdc, 12 A supply voltage (out of a 120Vac or 230Vac line power).

The RUSPSU-S consists of:

- one PSUTA-0001 (see “PSUTA-0001” on page 229) with a PSU-blind coverplate
- one PSU-UNI2412 power supply units (see “PSUTA-0001” on page 229)

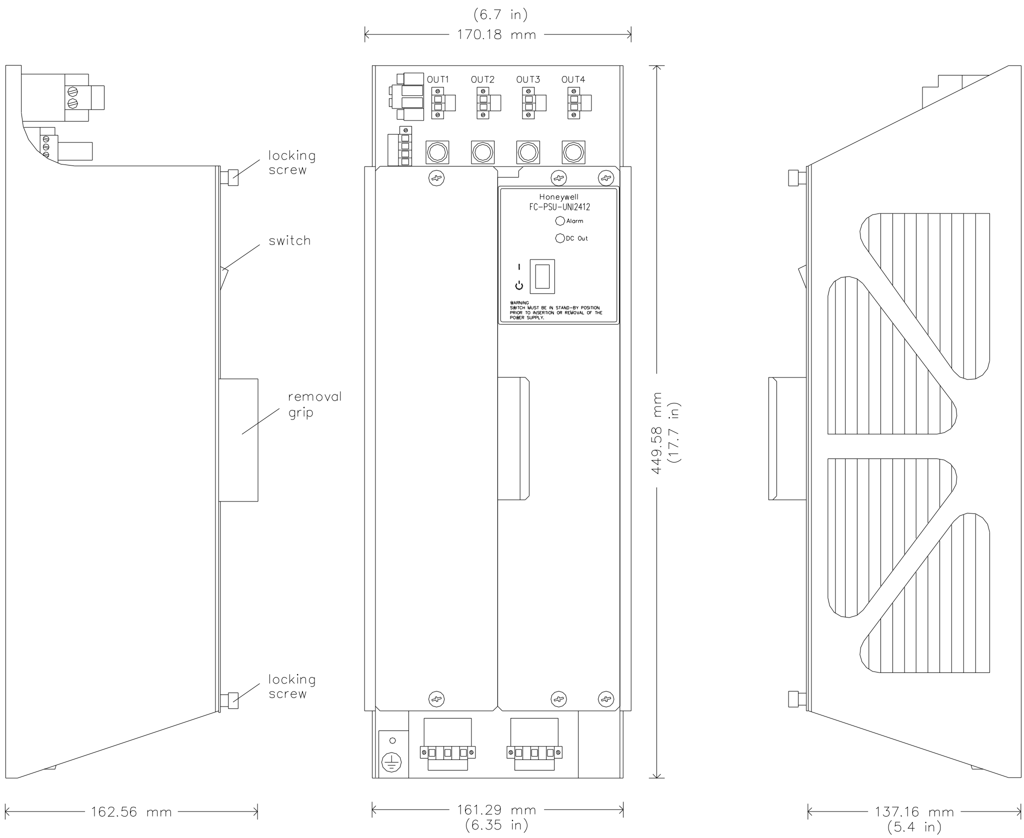
The RUSPSU-S is usable in SIL 3 applications.

Figure 138 on page 222 shows the physical appearance of the RUSPSU-S.

Warning:

The switch must be in ⏻ stand-by position prior to insertion or removal of the power supply.

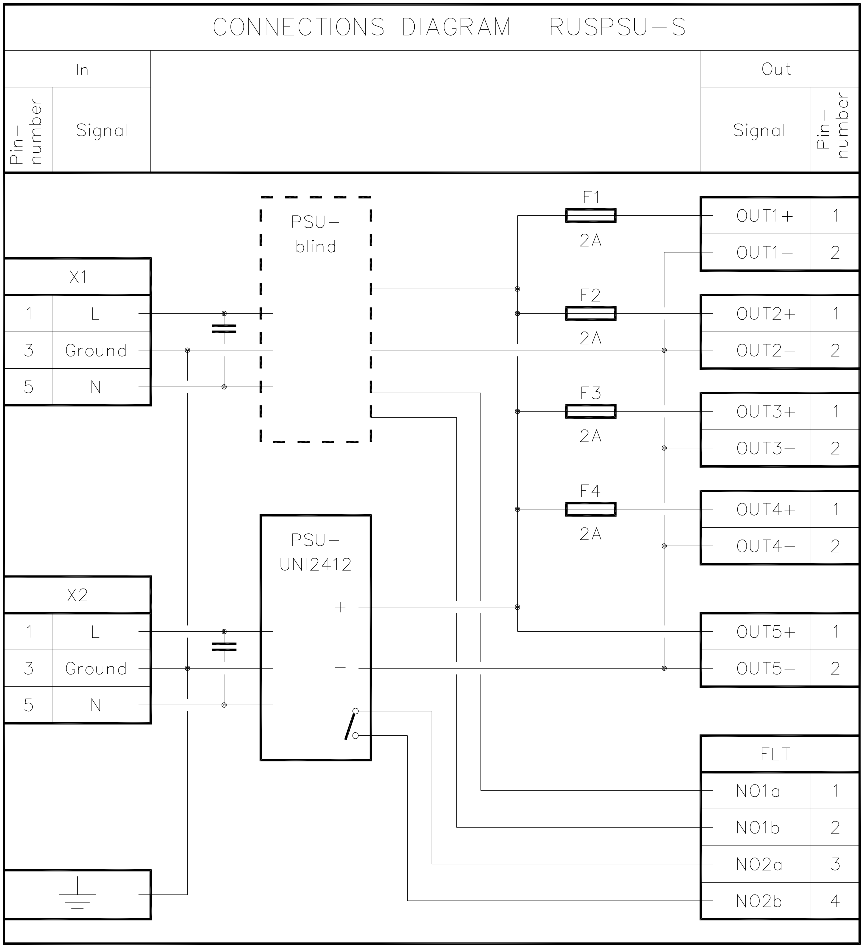
Figure 138 RUSPSU-S - mechanical layout



Connections

The connection diagram of the RUSPSU-S power supply assembly is as follows:

Figure 139 Connection diagram



Technical data

The RUSPSU-S power supply assembly has the following specifications:

General	Type number:	FC-RUSPSU-S
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV, IECEx pending
Power IN	Supply voltage:	102..132 Vac or 196 .. 253 Vac
	Frequency:	47 .. 63 Hz
	Connector name:	X2
Power OUT	Output voltage:	25 Vdc nominal
	Output current:	0 .. 12 A
	Connector name:	OUT1, OUT, OUT3, OUT4 (2 A fused)
	Connector name:	OUT5 (0 .. 12 A)
Alarm contact	Voltage	0 .. 30 Vac or Vdc
	Current:	0 .. 65 mA (non-inductive)
	Connector name:	FLT
Physical Data	Dimensions (H x W x D):	447.04 x 157.48 x 162.56 mm 17.6 x 6.2 x 6.4 in
	Weight:	5.2 kg 11.5 lbs

PSU-UNI2412

Power Supply unit 24 Vdc, 12 A

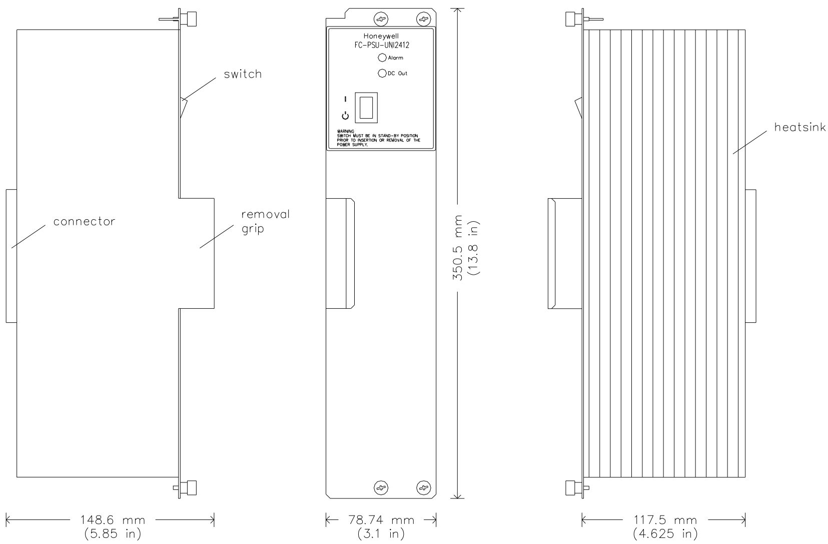
Description

The PSU-UNI2412 power supply unit is capable to supply up to 12A (out of a 115Vac or 230Vac line power) at 25Vdc nominal.

The two fault tolerant design makes it usable in SIL 3 applications.
Due to its two fault design the unit covers the SIL 3 safety integrity for the supply of all IO point connected Safety Integrity Functions (SIFs).

Figure 140 on page 225 shows the physical appearance of the PSU-UNI2412.

Figure 140 PSU-UNI2412 - mechanical layout



Configuration details:

- The PSU-UNI2412 must be placed in a PSUTA-0001 Power Supply Carrier (see “PSUTA-0001” on page 229).
- An RUSPSU-R offers a redundant 25Vdc 12 A supply (see “RUSPSU-R” on page 217).
- An RUSPSU-S offers a non-redundant 25Vdc 12 A supply (see “RUSPSU-S” on page 221).

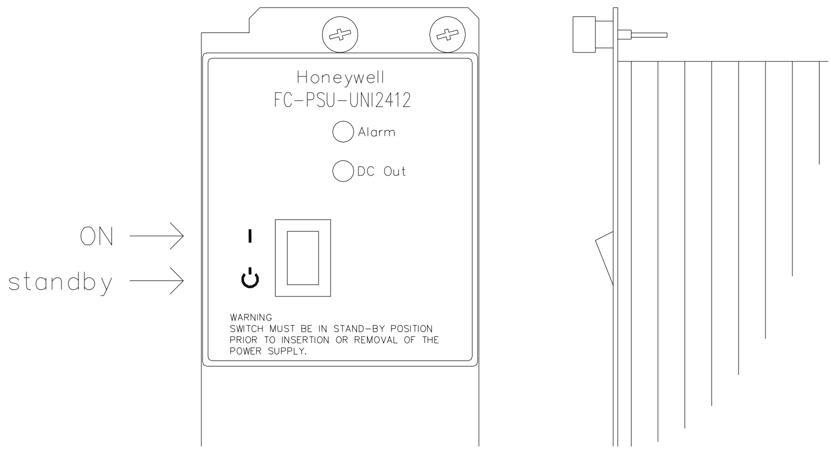
Hardware control features

Figure 141 on page 226 shows detailed views of the power and health and status indications of the unit.
The PSU-UNI2412 power supply has the following hardware control features:

- An ON/Standby switch
- Two LEDs for status indication,
  one for **Alarm** and one for **DC Out** indications
- Output over voltage protection (OVP)
- An alarm contact (for status)

Each of these features is discussed in more detail below.

Figure 141 PSU-UNI2412 - detailed views



ON/Standby switch

The ON/Standby switch has two positions. The side view on Figure 141 on page 226 shows the stand-by position.

Warning:

The switch must be in stand-by position prior to insertion or removal of the power supply.

Status indications

The **Alarm** LED is:

- Off when the unit is OK or has no power (on AC input)
- Red when the unit is powered (on AC input) but the 25V output is not OK (e.g. because the switch is in the stand-by position)
- Red and blinking when the internal temperature > 90 degC

The **DC Out** LED is:

- green when the 25V output voltage is OK (>22V)
- off when the 25V output voltage is lost

Over voltage protection

If an output overvoltage (OVP) is detected, the unit switches off.

An OVP reset requires interruption of the input AC line power, preferrably with the switch in the stand-by position.

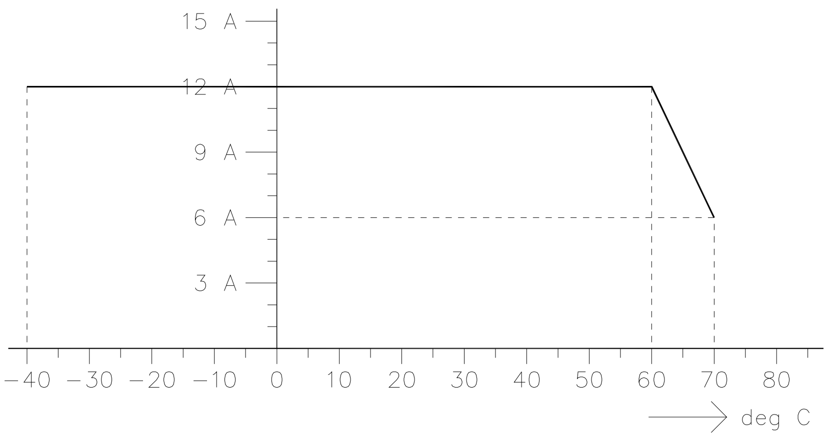
Alarm contact

The alarm contact is closed when the 25V output is OK (>22V).

Temperature derating

The maximum PSU ambient temperature at full load may not exceed 60 degC. At tempeartures above 60 degC, a derating of 0.6 Amp per degC must be applied. Figure 141 on page 226 shows the effects of temperature derating on the output current.

Figure 142 Derating curve for the PSU-UNI2412 power supply.



Technical data

The PSU-UNI2412 power supply unit has the following specifications:

General	Type number:	PSU-UNI2412
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)[1]
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV, IECEx pending
	Efficiency:	> 85%
	Power Factor correction:	yes
	Inrush current:	35A peak, measured at 60Hz 254 VAC
	Holdup time:	> 100ms (Vout > 22.5V; full load)
Power IN	Supply voltage:	102..132 Vac or 196 .. 253 Vac
	Frequency:	47 .. 63 Hz
Power OUT	Output voltage:	25 Vdc nominal
		between 24.3 .. 25.5 Vdc at output currents between 0.36 .. 12 A
	Output current:	0 .. 12 A
	OVP trip level:	28V
Alarm contact	Voltage	0 .. 30 Vac or Vdc
	Current:	0 .. 65 mA (non-inductive)
Physical Data	Dimensions (H x W x D):	350.5 x 78.74 x 148.6 mm 13.8 x 3.1 x 5.85 in
	Weight:	3.5 kg 7.7 lbs

1 Full output current can be supplied between -40 .. +60 degC; at higher temperatures derating applies. For details refer to “Temperature derating” on page 227.

PSUTA-0001

Power supply carrier 0001

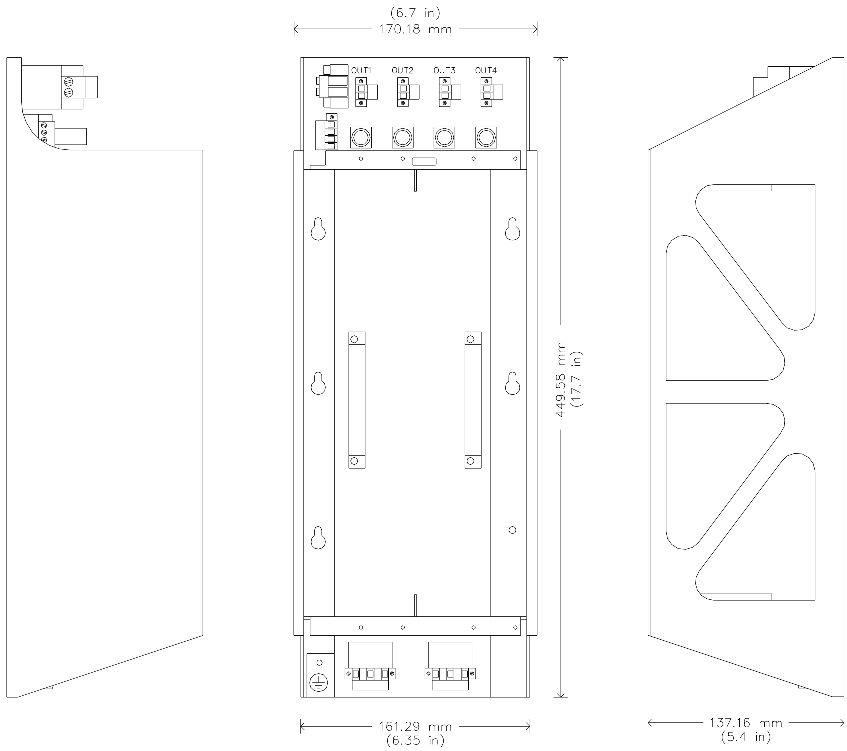
Description

The PSUTA-0001 is a Power Supply Unit Termination Assembly, and it can be equipped with one of the configurations listed below:

- two PSU-UNI2412 power supply units (refer to "RUSPSU-R" on page 217),
- one PSU-UNI2412 and a PSU dummy (refer to "RUSPSU-S" on page 221).

For physical representations of the PSUTA-0001 see Figure 143 on page 229.

Figure 143 Mechanical layout



The PSUTA-0001 consists of:

- a metal frame
- a PCB
- two (AC) power input connectors
- one ground connection point (M4 thread)
- two connectors for PSU-UNI2412 power supply units
- one 25Vdc power output connector
- four fused 25Vdc output connectors
- one FLT (fault) output contacts connector

Pin allocation

POWER IN connectors

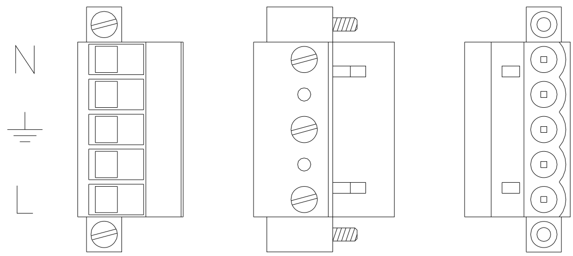
See the figure below for a top, side & bottom view of the POWER IN connectors.

The two (110Vac or 230Vac) POWER IN connectors (**X1** and **X2**) are situated on the lower side of the PCB.

The pin assignment of connectors **X1** and **X2** is:

- pin 5: Neutral (N)
- pin 3: Ground
- pin 1: Line (L)

Figure 144 POWER IN connectors X1 and X2



On the left of the POWER IN connectors you will find the primary Ground connection point (with M4 thread).

Fused 25Vdc out connectors

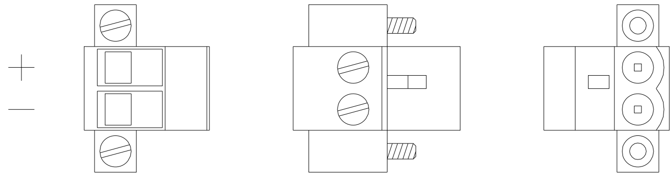
Figure 145 on page 231 shows the top, side & bottom view of the (2 A fused) 25Vdc out connectors.

The 25Vdc out connectors are situated on the upper side of the PCB.

There are four of these 25Vdc out connectors (**OUT1**, **OUT2**, **OUT3** and **OUT4**).

1. The pin marked "+" is pin 1; it has a fused +25Vdc connection.
2. The pin marked "-" is pin 2; it has an unfused connection with 0Vdc.

Figure 145 Fused 25Vdc out connectors OUT1 thru OUT4



Main 25Vdc out connectors

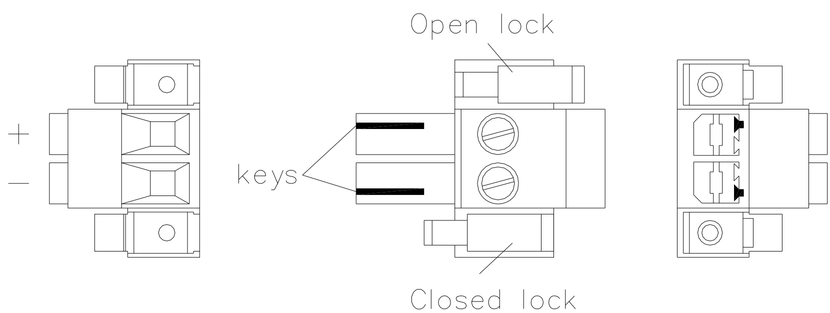
Figure 146 on page 231 shows the top, side & bottom view of the main 25Vdc out connector.

The main 25Vdc out connector (**OUT5**) is situated on the upper side of the PCB.

* The pin marked "+" is pin 1. It is connected with +25Vdc.

* The pin marked "-" is pin 2. It is connected with 0Vdc.

Figure 146 Main 25Vdc out connector OUT5



The two (red) locking slides of the cable-connector in Figure 146 on page 231 keep the cable-connector locked on the PSUTA-0001.

Fault connector

Figure 147 on page 232 shows the top, side & bottom view of the Fault connector.

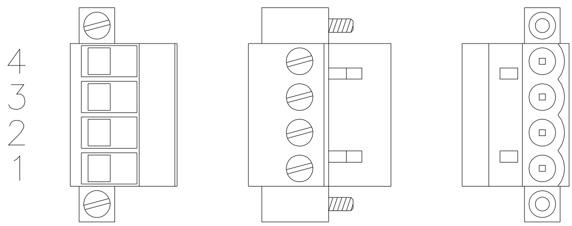
The Fault connector (FLT) is situated on the upper side of the PCB.

The Fault connector combines the contacts of the Power-OK relays of PSU1 and PSU2. These contacts are only closed if the PSU is OK and powered up.

The Power-OK contact of PSU1 is connected between pins 1 and 2 of the Fault connector.

The Power-OK contact of PSU2 is connected between pins 3 and 4 of the Fault connector.

Figure 147 Fault connector FLT



Fuses

Caution:

For continued protection against risk of fire, replace only with same type and rating of fuse.

Fuse replacement is only allowed under no load condition.
Two examples of how to achieve this are listed below:

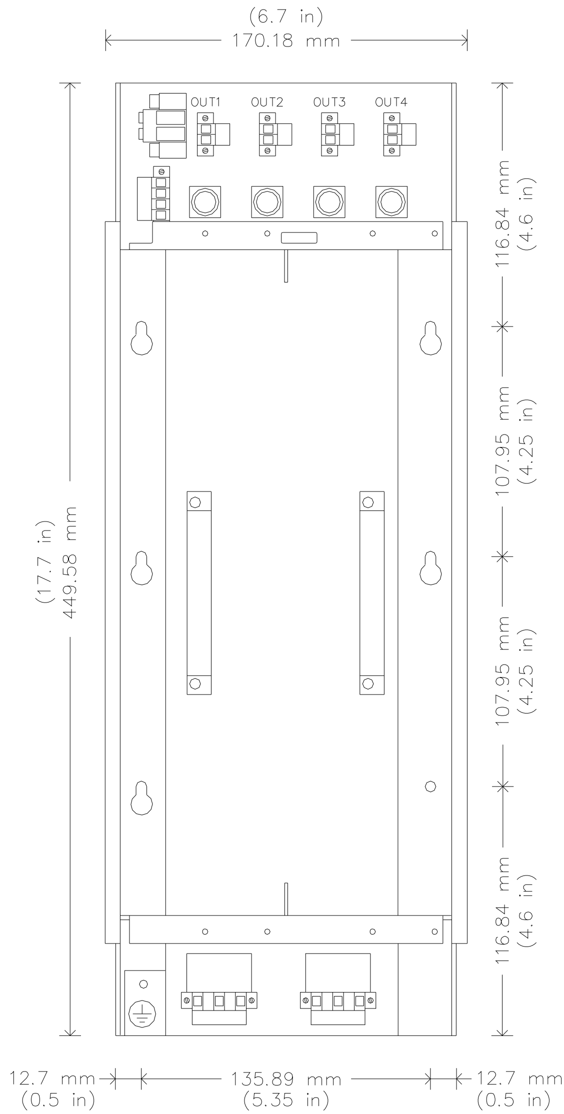
- remove or disconnect the field load,
- put the switch(es) of the (both) PSU in stand-by position.

Mounting

The PSUTA-0001 can be screwed on a flat surface. Figure 148 on page 233 shows the coordinates of the (six) screw holes. Relevant details are:

- The screw shaft can be up to 5 mm
- The screw head can be up to 11 mm

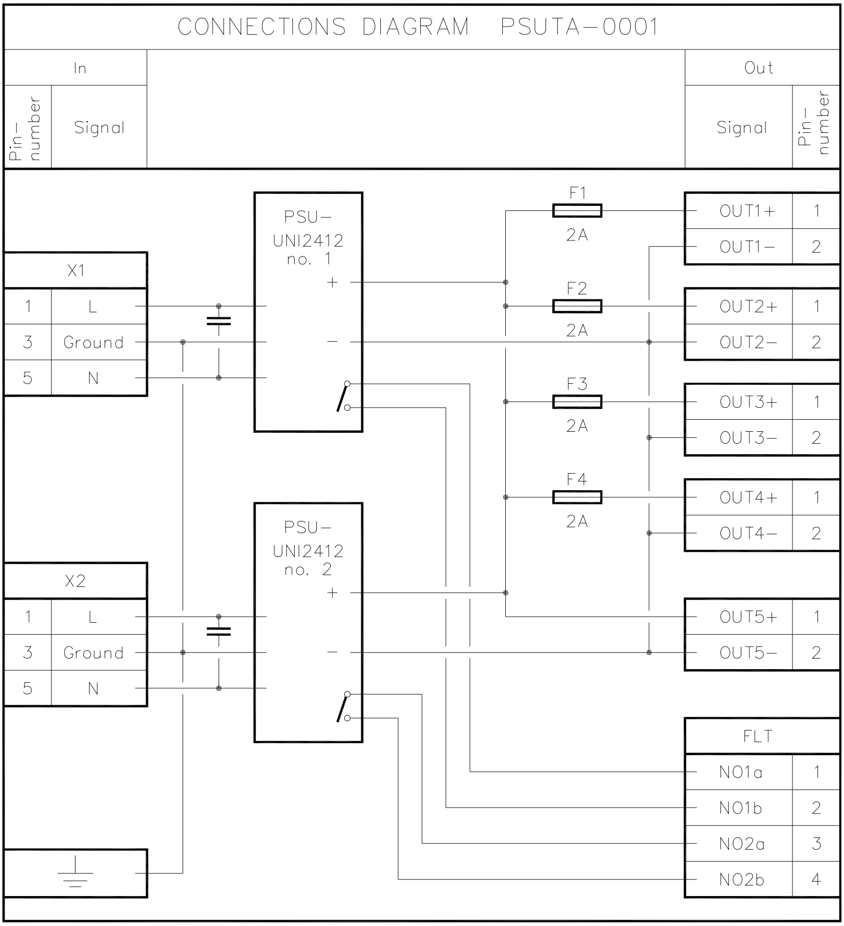
Figure 148 Top view with mounting hole coordinates



Connections

Figure 149 on page 234 shows the connection diagram of the PSUTA-0001.

Figure 149 Connection diagram



Technical data

The PSUTA-0001 has the following specifications:

General	Type number:	FC-PSUTA-0001
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE, UL; TUV, IECEx pending
Power IN	Supply voltage:	0 .. 260 Vac
	Supply current:	none
Power OUT	Output voltage:	25 Vdc nominal
	Output current OUT1..4:	max. 2 A
	Output current OUT5:	max. 12 A
	Fuses:	
	• rating:	max. 2 AT (slow acting)
	• dimensions:	32 x 6.3 mm (0.25 x 1.25 in)
	FLT:	
	• voltage:	max. 30Vac or 36Vdc
	• current:	max. 0.5 A
Connectors	Power IN:	5 pole header (3 pins used)
	• make and type:	Weidmuller: BLZ 5.08/5F SN SW
	Ground:	M4 thread (approx. 10 mm)
	25V supply fused:	2 pole header
	• make and type:	Weidmuller: BLZ 5.08/2F SN SW
	25V supply main:	2 pole header with keying
	• make and type:	Weidmuller: BVZ 7.62HP/02F SN (conn.) Weidmuller: BV/SV7.62HP KO (keys)
	FLT:	4 pole header
	• make and type:	Weidmuller: BLZ 5.08/4F SN SW
Physical Data	Dimensions (H x W x D):	137.2 x 157.5 x 447 mm 5.4 x 6.2 x 17.6 in
	Weight:	3.2 kg 7.0 lbs

Control Processor modules

7

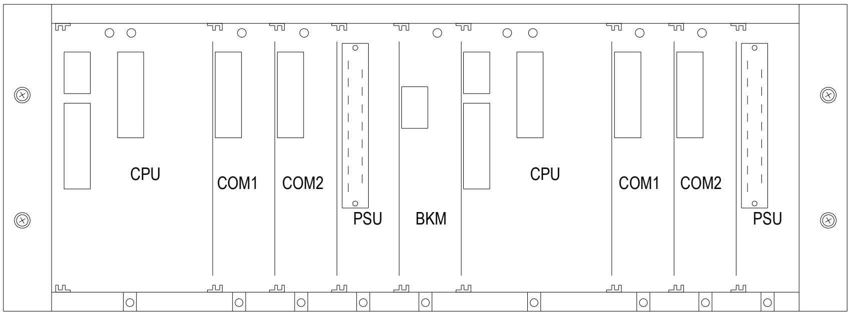
This chapter describes the following Control Processor modules:

Module		See
QPP-0001	Quad Processor Pack	page 240
QPP-0002	Quad Processor Pack	page 253
USI-0001	Universal Safety Interface	page 266
USI-0002	Universal Safety Interface	page 271
BLIND-COM	Dummy communication module	page 275
BKM-0001	Battery and Key switch Module	page 277
PSU-240516	Power Supply Unit 24/5 Vdc, 16 A	page 284

General info about Control Processor modules

Each Safety Manager Control Processor module is located in a pre-determined slot in the Controller chassis (see section "CPCHAS-0001" on page 87 or "CPCHAS-0002" on page 116). Connectors and earth/keying pins in the backplane ensure they can only be placed in the slot reserved for that type of Control Processor module (see Figure 150 on page 238).

Figure 150 Front view of an empty Controller chassis



All connections and communication from and to Control Processor modules run via the Controller backplane (see section "Controller backplane CPB-0001" on page 91).

Table 34 available Control Processor modules and their functionality

Control Processor module		Functionality
QPP-0001 QPP-0002	Quad Processor Pack Quad Processor Pack	• two -synchronous- processors • flash memory for system and application program • RAM with battery backup (battery located in BKM-0001) • data comparators for the processors and their memory • a redundant communication link with the other Control Processor • data exchange with its communication modules • watchdog (fully testable) with: - minimum and maximum execution time monitor - memory error handler - 1oo2D functionality - 24V and 5V monitoring - emergency Shut Down Input (24V) - two outputs (for non-redundant resp. redundant IO) • four IObus drivers • diagnostics display • temperature monitors • real time clock
USI-0001 USI-0002	Universal Safety Interface Universal Safety Interface	• two 10/100 Mb Ethernet channels • two general purpose SCC channels
BKM-0001	Battery and Key switch Module	• backup batteries for CP1 and CP2 • Reset key switch • Force Enable key switch • three general purpose inputs (24 VDC)
PSU-240516	Power Supply Unit 24/5 Vdc, 16 A	• dual 5 V supply (out of 24 VDC) for: - Control Processor and redundant IO - non-redundant IO

QPP-0001

Quad Processor Pack

Description

The Quad Processor Pack (QPP-0001) is the processing module of Safety Manager and is located in the Controller chassis (see section “CPCHAS-0001” on page 87).

Attention

You can only remove or replace the QPP-0001 module safely when the key switch is in STOP!

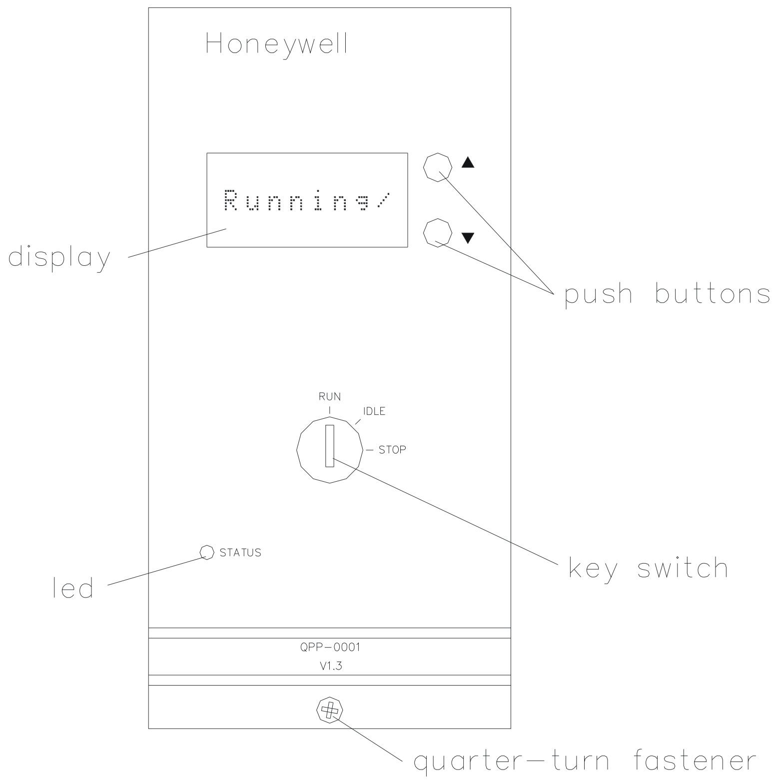
A non-redundant Controller contains one QPP-0001 module, a redundant Controller contains two QPP-0001 modules.

The slot of the Quad Processor Packs within the Controller chassis is pre-determined (see “Location of Control Processor modules” on page 89).

The Quad Processor Pack (QPP-0001) is the heart of Safety Manager. It controls all system operations. The QPP-0001 module reads the IO input signals and executes the Controller File as created by the user in graphical Functional Logic Diagrams (FLDs). The results of the Controller File are then transmitted to the output interfaces. In Safety Manager configurations with a redundant Controller, the two QPP-0001 modules synchronize their operation through a dedicated redundant communication link between the two Control Processors. Continuous testing of the Safety Manager hardware by the QPP-0001 module ensures safe control of the process as well as extensive system and process equipment diagnostics.

The QPP-0001 module has two processors and two memory sets. Hardware data-comparators compare every read and write action of the processors, and trip the watchdog if any difference in the data is detected. Additional test hardware enables full testing of the QPP-0001 module to achieve diagnostic coverage higher than 99%. This allows one QPP-0001 module to run applications up to and including SIL3 without time limitation. Redundant Controller configurations result in a 2oo4D voting architecture.

Figure 151 the front view of the QPP-0001



The QPP-0001 has the following components:

- two processors running synchronously
- flash memory for system and application program
- RAM with battery backup (battery located in BKM-0001)
- a redundant communication link with the other Control Processor
- RAM for the redundant communication link data
- data comparators for the processors and their memory
- data exchange with its communication modules
- watchdog (fully testable) with:
    - minimum and maximum execution time monitor
    - memory error handler
    - 1oo2D functionality

- 24V and 5V monitoring
- emergency Shut Down Input (24V)
- two outputs (for non-redundant resp. redundant IO)

- four IObus drivers
- diagnostics display
- temperature monitors
- real time clock

Processors

The QPP-0001 module has two processors running synchronously during process control. During an (application-) download they may get out of sync, but after the download they will re-synchronize.

The processors run the system program (including extensive self tests and diagnostic routines) and the application program.

Memory

The QPP-0001 module has the following on-board memory:

- 2 × 2 Mbyte flash for the system and application program.
- 2 × 256 kbyte SRAM with battery backup (for IO, markers, counters, timers and registers).
- 2 × 512 kilobyte SRAM for data-exchange with the other Control Processor.

The flash contents can be updated without removing the QPP-0001 from the Controller chassis.

User interface

The QPP-0001 module has the following features for indicating the Controller status and allowing the user to start, stop, reset, power-up and power-down the Control Processor:

- User Interface Display (see page 243)
- Processor Status Key Switch (see page 245)
- Status LED (see page 246)

User interface display

Note:

The information on the user display may vary depending on the software version installed in the QPP.

The QPP module has a user interface display that informs the user of the status of the Control Processor and all the IO related to it.

The eight-digit display shows one message at a time, and the user can scroll between messages with the use of the buttons on the right-hand side of the display (see Figure 152 on page 243).

Many messages, like diagnostic messages, are divided into sub-messages, called stages (see Table 35 on page 244). The user interface display automatically scrolls through these stages within the current message.

When left alone for 30 seconds, the user interface display returns to the default status message.

Figure 152 the user interface display of the QPP-0001 and the QPP-0002

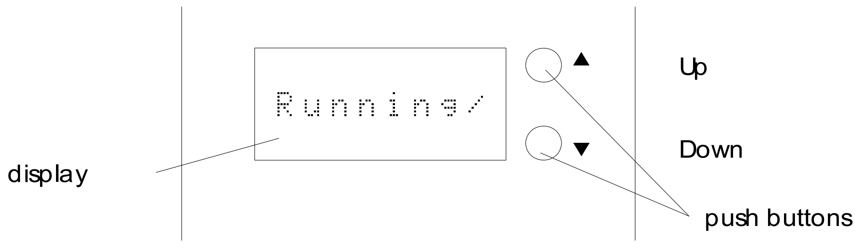


Table 35 Messages displayed by the User Interface Display of the QPP module

Scroll	Message	Description
	Fail	Shows the number of diagnostic messages (N)
	Frc	Shows the number of forced points
	IP 2B IP 2A IP 1B IP 1A	Shows the details for the selected COM port. If a COM port is configured the display shows: IP address (in two steps); Gateway; Gateway IP address (in two steps). If a COM port is not configured the display shows: Not Config.; Gateway Not Config. (in two steps).
↑	Sys	Shows the Controller node number
	Vb	Shows the battery voltage for this Control Processor in Volts
Up	Vcc	Shows the 5VDC PSU output voltage for this Control Processor in Volts
Down	Tmp	Shows the temperature for this Control Processor
	Date	Shows the actual date
↓	Time	Shows the actual time
	R #version no.#	Shows the software version number
	Default status message[1]	**For details see Table 36 on page 245**
	Diagnostic message N ↓ 1. Chass 2. Slot 3. Module ID 4. Message 1 5. Message 2 6. Error # Diagnostic message N-1 ↓ 1. Chass 2. Slot 3. Module ID 4. Message 1 5. Message 2 6. Error #	Shows the diagnostic messages that apply for this Controller. If there are no messages the display shows “Fail 0”. If there are multiple messages the last 32 messages are displayed in chronological order. The last message is shown first. Select a message with the scroll buttons. When releasing a scroll button on a diagnostic message the display scrolls: • the fault location in two steps (chassis and slot), • the faulty module in the next step (module ID) • the message body in two steps (Message 1 & 2) • the error code in the next step (Error #) After completing this cycle the display returns to the default status message.

1 **When selecting another display message with the scroll buttons, the display will always return to this message after a time-out.**

Table 36 Possible default status messages

Status	Message[1]	Alternating with
Busy with power-on checks	`PowerUp`	
Busy synchronizing	`Sync`	
Busy loading	`Loading`	
Waiting for download to start	`Waiting`	
Waiting for download to start	`Waiting`	`with Flt`
Key in `IDLE`: CP halted	`Halt`	
Key in `RUN`: CP halted due to faults	`Halt`	`with Flt`
Key in `RUN`: CP ready to start	`CPReady`	
Running with faults	`Running`	`with Flt`
Running no faults	`Running`	
Loading other CP, or loading own USI	`Sending`	

1 A continuously rotating bar or a flashing star on the display indicates that the QPP is operational.

Processor status key switch

The QPP-0001 module contains a processor status key switch that enables the user to change the Control Processor status. This key is different from the keys of the key switches on the BKM-0001 module.

Table 37 on page 245 shows the possible statuses of the Processor Status Key Switch.

Table 37 Positions of the processor status key switch

Processor status key	Description
RUN	The Control Processor executes (or is ready to execute) the Application File.
IDLE	The execution of the application program is ended by the processors. The current application and memory contents are not affected by the IDLE state. The Control Processor is available for loading software. The watchdog outputs are de-activated by the processor.

Table 37 Positions of the processor status key switch

Processor status key	Description
STOP	The Control Processor is in Hardware Reset. It is not executing any program. The watchdog outputs are de-activated. The IObus drivers are de-energized.

Status LED

The QPP-0001 has one STATUS LED on the front side of the module.

Table 38 on page 246 shows the possible states of this STATUS LED.

Table 38 LED indicators of the QPP-0001 module

LED	Status	Description
STATUS	Off	The power to the module is down or the Processor Status Key Switch is set to **STOP**.
	Red	One or more hardware errors detected on the module.
	Green	No hardware errors detected on the module.

SD input

The QPP-0001 has a (24 Vdc) emergency Shut Down input.

A low level on the emergency Shut Down input will de-energize the watchdog outputs independently from the processor. The SD input is available on the Controller backplane and requires a normally closed (field-)contact.

The SD input is common for both Control Processors. The +24 V_SD-output is supplied by both QPP-0001 modules, but the input stays operational even if one of the QPP-0001 modules has no 24 Vdc supply, or is removed.

- If the SD function is used you should connect an external potential free SD contact via the SICP-0002/L3 (see “SICP-0002/L3” on page 722).
- If the SD function is not used an SD link is required (default placed on the CP backplane).

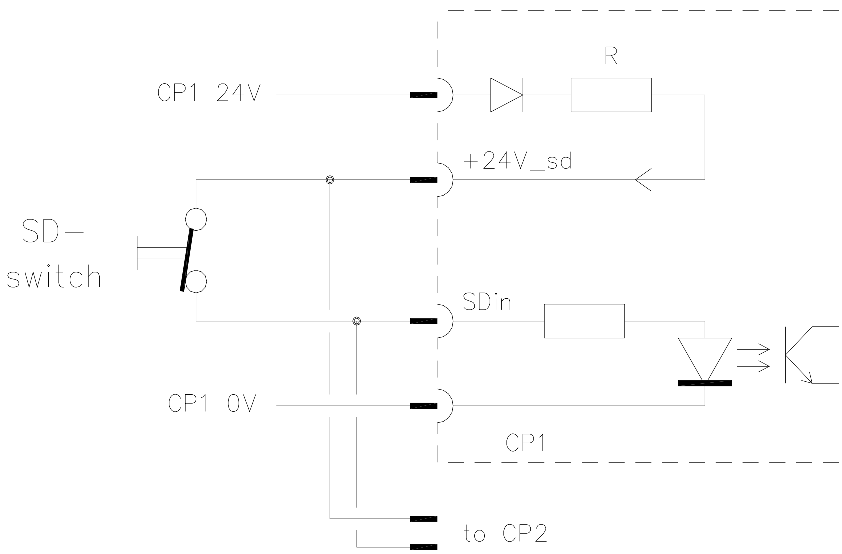
This SD input is 24 Vdc and galvanically isolated from the internal 5 Vdc (see Figure 153 on page 247).

Note:

The resistor R on the 24 V input circuit of the SD input in Figure 153 on page 247 limits the short-circuit current (to 0 V) of the +24 V_sd signal.

The external potential free SD switch is connected via a SICP-0002/L3 cable. For more details see “SICP-0002/L3” on page 722 and “CPCHAS-0001” on page 87.

Figure 153 SD input schematic



Watchdog functionality

The Watchdog function in the QPP-0001 monitors the operation and the operating condition of the processors. The processor operation is monitored by verifying whether the processors execute all the tasks within a pre-calculated time frame, which depends on the configuration. The monitored operating conditions include the data integrity of the processor memory, the (5 V) processor supply voltage and the (24 V) IO supply voltage (both undervoltage and overvoltage). If the Watchdog detects a fault in the operation of the QPP-0001 or its operating conditions, it will deactivate its outputs and thus deactivates the safety-critical outputs of Safety Manager, independent of the QPP-0001 status.

The watchdog module monitors system parameters including:

- The application loop maximum execution time. This in order to detect if the process is executing its program correctly and is not looping (hang-up).
- The application loop minimum execution time. This in order to detect if the processor is executing its program correctly and is not skipping program parts.
- Data (-bus) differences. This will detect memory errors and processor defects.
- 5 Vdc level. Overvoltage and undervoltage detection (5 Vdc ± 5%).
- 24 Vdc level. Overvoltage and undervoltage detection (24 Vdc –20%, +35%).
- SD input signal level.

The watchdog also includes the following features:

- A 1oo2D functionality.
  The processor has the capability to de-energize the watchdog of the other (redundant) processor in the Controller chassis.
- A (second) watchdog-output for the non-redundant IO modules.
  This output is connected in parallel with the (second) output of the other processor in the Controller chassis. The output is used to energize the watchdog input of non-redundant IO chassis and will stay ‘high’ as long as at least one of the processors keeps its (second) output high. If a fault is detected in a module in the non-redundant IO section, the processors can switch off this ‘second’ watchdog-output and keep the redundant IO modules online.

In order to be able to test all watchdog functions, the watchdog module is duplicated. The outputs are switched in parallel (‘wired OR’ function) to enable a trip of one section without losing the watchdog signal to the IO.

Figure 154 on page 249 and Figure 155 on page 250 show the watchdog section and watchdog outputs schematics.

Figure 154 Watchdog section schematic

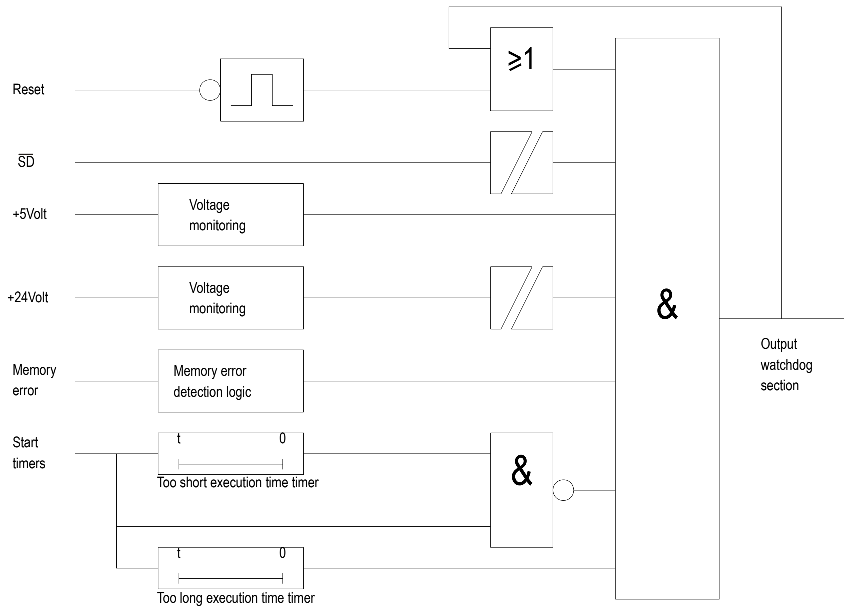
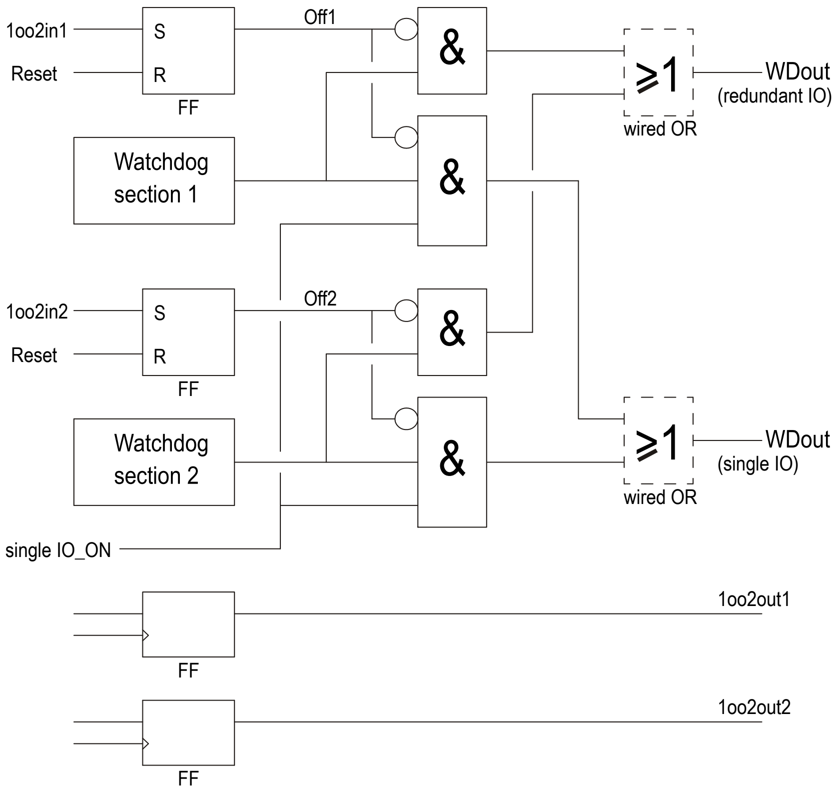


Figure 155 Watchdog outputs schematic



The lower two flip-flops in Figure 155 on page 250 latch the (outgoing 1oo2D) commands to de-energize the watchdog (parts) of the (redundant) processor. These outputs of the (redundant) processor are connected to the (1oo2D) inputs of this watchdog (‘1oo2in1’ and ‘1oo2in2’ in Figure 155 on page 250).

Each WD_{out} output can drive 750mA.

Diagnostics

The following diagnostics are performed by the QPP-0001 module:

- QPP-0001 generates an alarm and event when battery voltage drops below the data retention voltage. The "data retention voltage" is defined as the absolute minimum voltage needed for a device to correctly maintain the contents of their RAM circuits. This voltage is standard 2.0 V.
- QPP-0001 generates an alarm and event when the battery lifetime expires.
- The 5 Vdc voltage 'too high' or 'too low' will be alarmed.
  The 24 Vdc voltage 'too high' or 'too low' will be alarmed.
- The diagnostics on the hardware comparators will detect "stuck-at" and "shorts between inputs and outputs of the comparators".
- The fault reaction to faults detected in the temperature monitoring function will result in an alarm, unless the temperature measured by the other Control Processor differs less then 3 degrees Celsius from a shutdown limit. In the latter case, an automatic shutdown of the Control Processor is initiated.
- Faults detected in the 10 ms base timer function result in automatic Control Processor shutdown.
- The fault reaction on a hardware failure detected by the hardware comparators of the application processor will result in an alarm to the safety processor, which initiates a Control Processor shutdown.

The following diagnostics are defined for the BKM-0001 (most electronics for execution of these functions are located on the QPP-0001):

- The BKM-0001 is not placed.
- Battery voltage is out of range (too high, too low and open circuit).
- The safety processor will have the capability and possibility to indicate a faulty battery status on the status LED of the BKM-0001.

Technical data

General	Type numbers[1 2]:	FS-QPP-0001 V1.3
		FC-QPP-0001 CCV1.3
	Operating temperature:	
	• outside module temperature:	–5°C—+70°C (+23°F—+158°F)
	• inside module temperature:	–5°C—+70°C (+23°F—+158°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Relative humidity:	10—95% (non condensing)
	Approvals:	CE, UL, CSA, TUV, FM
Power	24 V supply voltage:	24 Vdc –15%—+30%
	24 V supply current:	max. 25 mA
	5 V supply voltage:	5 Vdc ± 5%
	5 V supply current:	max 1.2 A
+24 V_sd	Output supply voltage:	15—31 Vdc
	Output resistance:	approx. 1.1 kΩ
	Short circuit proof:	continuous
SD input	Voltage (high):	15—32 Vdc
	Voltage (low):	<4 V (reverse polarity protected)
	Input current:	approx. 8mA at 24 Vdc
WD_{out} output	Output current:	750mA per output
Physical	Dimensions: (H × W× D)	176 × 88.5 × 212 mm 6.93 × 3.48 × 8.35 in
	Weight:	1,3 kg

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.x or CCV1.x have an improved PCB design. There are no functional changes.

QPP-0002

Quad Processor Pack

Description

The Quad Processor Pack (QPP-0002) is the second generation (enhanced performance) processing module of Safety Manager and is located in the Controller chassis (see section "CPCHAS-0001" on page 87 or "CPCHAS-0002" on page 116).

The QPP-0002 is backwards compatible with, and a one-on-one spare part for the QPP-0001, when installed in Safety Managers running R121 firmware or higher.

Attention

You can only remove or replace the QPP-0002 module safely when the key switch is in STOP!

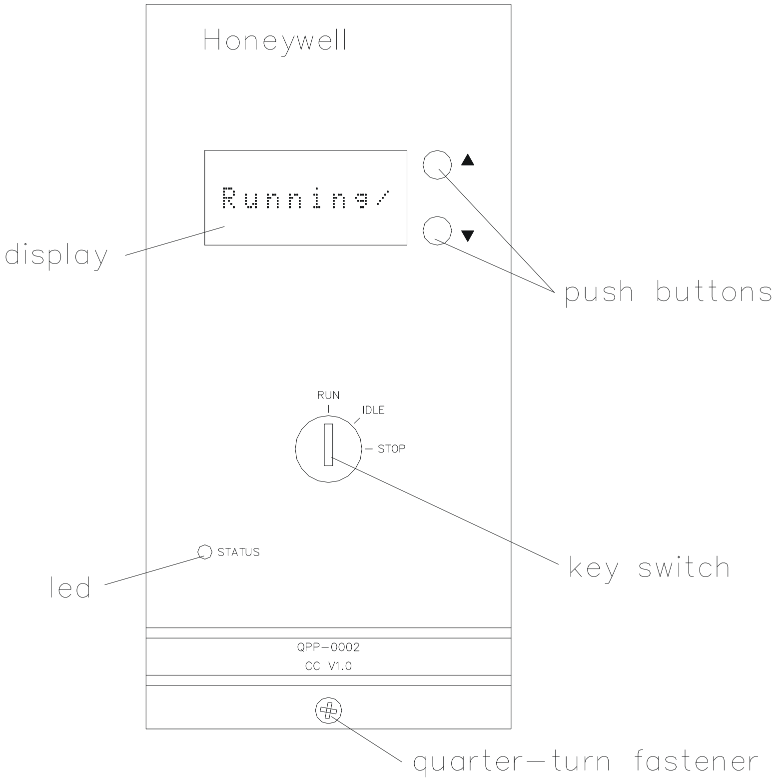
A non-redundant Controller contains one QPP-0002 module, a redundant Controller contains two QPP-0002 modules.

The slot of the Quad Processor Packs within the Controller chassis is pre-determined (see "Location of Control Processor modules" on page 89).

The Quad Processor Pack (QPP-0002) is the heart of Safety Manager. It controls all system operations. The QPP-0002 module reads the IO input signals and executes the Controller File as created by the user in graphical Functional Logic Diagrams (FLDs). The results of the Controller File are then transmitted to the output interfaces. In Safety Manager configurations with a redundant Controller, the two QPP-0002 modules synchronize their operation through a dedicated redundant communication link between the two Control Processors. Continuous testing of the Safety Manager hardware by the QPP-0002 module ensures safe control of the process as well as extensive system and process equipment diagnostics.

The QPP-0002 module has two processors and two memory sets. Hardware data-comparators compare every read and write action of the processors, and trip the watchdog if any difference in the data is detected. Additional test hardware enables full testing of the QPP-0002 module to achieve diagnostic coverage higher than 99%. This allows one QPP-0002 module to run applications up to and including SIL3 without time limitation. Redundant Controller configurations result in a 2oo4D voting architecture.

Figure 156 the front view of the QPP-0002



The QPP-0002 has the following components:

- two processors running synchronously
- flash memory for system and application program
- flash memory for backup of system and application program
- RAM with battery backup (battery located in BKM-0001)
- a redundant communication link with the other Control Processor
- RAM for the redundant communication link data
- data comparators for the processors and their memory
- data exchange with its communication modules
- watchdog (fully testable) with:
  - minimum and maximum execution time monitor
  - memory error handler

- 1oo2D functionality
- 24V and 5V monitoring
- emergency Shut Down Input (24V)
- two outputs (for non-redundant resp. redundant IO)

- four IObus drivers
- diagnostics display
- temperature monitors
- real time clock

Processors

The QPP-0002 module has two processors running synchronously during process control. During an (application-) download they may get out of sync, but after the download they will re-synchronize.

The processors run the system program (including extensive self tests and diagnostic routines) and the application program.

Memory

The QPP-0002 module has the following on-board memory:

- 2 × 2 Mbyte flash for the system and application program.
- 2 × 256 kbyte SRAM with battery backup (for IO, markers, counters, timers and registers).
- 2 × 512 kilobyte SRAM for data-exchange with the other Control Processor.
- 1 x 16 Mbyte flash for backup of system and application program.

The flash contents can be updated without removing the QPP-0002 from the Controller chassis.

User interface

The QPP-0002 module has the following features for indicating the Controller status and allowing the user to start, stop, reset, power-up and power-down the Control Processor:

- User Interface Display (see page 256)
- Processor Status Key Switch (see page 258)
- Status LED (see page 259)

User interface display

Note:

The information on the user display may vary depending on the software version installed in the QPP.

The QPP module has a user interface display that informs the user of the status of the Control Processor and all the IO related to it.

The eight-digit display shows one message at a time, and the user can scroll between messages with the use of the buttons on the right-hand side of the display (see Figure 157 on page 256).

Many messages, like diagnostic messages, are divided into sub-messages, called stages (see Table 39 on page 257). The user interface display automatically scrolls through these stages within the current message.

When left alone for 30 seconds, the user interface display returns to the default status message.

Figure 157 the user interface display of the QPP-0001 and the QPP-0002

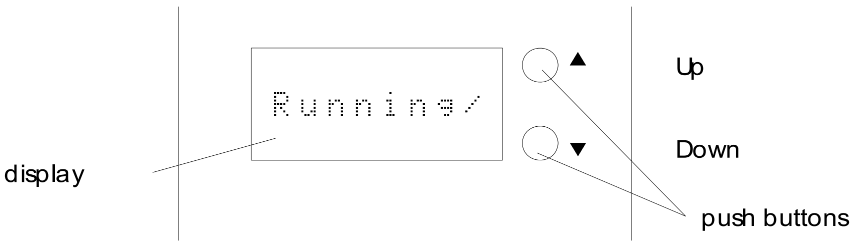


Table 39 Messages displayed by the User Interface Display of the QPP module

<table>
<tr><th>Scroll</th><th>Message</th><th>Description</th></tr>
<tr><td rowspan="15">↑
Up
Down
↓</td><td>Fail</td><td>Shows the number of diagnostic messages (N)</td></tr>
<tr><td>Frc</td><td>Shows the number of forced points</td></tr>
<tr><td>IP 2B
IP 2A
IP 1B
IP 1A</td><td>Shows the details for the selected COM port.
If a COM port is configured the display shows: IP address (in two steps); Gateway; Gateway IP address (in two steps).
If a COM port is not configured the display shows: Not Config.; Gateway Not Config. (in two steps).</td></tr>
<tr><td>Sys</td><td>Shows the Controller node number</td></tr>
<tr><td>Vb</td><td>Shows the battery voltage for this Control Processor in Volts</td></tr>
<tr><td>Vcc</td><td>Shows the 5VDC PSU output voltage for this Control Processor in Volts</td></tr>
<tr><td>Tmp</td><td>Shows the temperature for this Control Processor</td></tr>
<tr><td>Date</td><td>Shows the actual date</td></tr>
<tr><td>Time</td><td>Shows the actual time</td></tr>
<tr><td>R #version no.#</td><td>Shows the software version number</td></tr>
<tr><td>Default status message[1]</td><td>For details see Table 40 on page 258</td></tr>
<tr><td>Diagnostic message N</td><td rowspan="4">Shows the diagnostic messages that apply for this Controller.
If there are no messages the display shows “Fail 0”.
If there are multiple messages the last 32 messages are displayed in chronological order. The last message is shown first.
Select a message with the scroll buttons. When releasing a scroll button on a diagnostic message the display scrolls:
• the fault location in two steps (chassis and slot),
• the faulty module in the next step (module ID)
• the message body in two steps (Message 1 & 2)
• the error code in the next step (Error #)
After completing this cycle the display returns to the default status message.</td></tr>
<tr><td>↓ 1. Chass
2. Slot
3. Module ID
4. Message 1
5. Message 2
6. Error #</td></tr>
<tr><td>Diagnostic message N-1</td></tr>
<tr><td>↓ 1. Chass
2. Slot
3. Module ID
4. Message 1
5. Message 2
6. Error #</td></tr>
</table>

1 When selecting another display message with the scroll buttons, the display will always return to this message after a time-out.

Table 40 Possible default status messages

Status	Message[1]	Alternating with
Busy with power-on checks	`PowerUp`	
Busy synchronizing	`Sync`	
Busy loading	`Loading`	
Waiting for download to start	`Waiting`	
Waiting for download to start	`Waiting`	`with Flt`
Key in `IDLE`: CP halted	`Halt`	
Key in `RUN`: CP halted due to faults	`Halt`	`with Flt`
Key in `RUN`: CP ready to start	`CPReady`	
Running with faults	`Running`	`with Flt`
Running no faults	`Running`	
Loading other CP, or loading own USI	`Sending`	

1 A continuously rotating bar or a flashing star on the display indicates that the QPP is operational.

Processor status key switch

The QPP-0002 module contains a processor status key switch that enables the user to change the Control Processor status. This key is different from the keys of the key switches on the BKM-0001 module.

Table 41 on page 258 shows the possible statuses of the Processor Status Key Switch.

Table 41 Positions of the processor status key switch

Processor status key	Description
RUN	The Control Processor executes (or is ready to execute) the Application File.
IDLE	The execution of the application program is ended by the processors. The current application and memory contents are not affected by the IDLE state. The Control Processor is available for loading software. The watchdog outputs are de-activated by the processor.

Table 41 Positions of the processor status key switch

Processor status key	Description
STOP	The Control Processor is in Hardware Reset. It is not executing any program. The watchdog outputs are de-activated. The IObus drivers are de-energized.

Status LED

The QPP-0002 has one STATUS LED on the front side of the module.

Table 42 on page 259 shows the possible states of this STATUS LED.

Table 42 LED indicators of the QPP-0002 module

LED	Status	Description
STATUS	Off	The power to the module is down or the Processor Status Key Switch is set to **STOP**.
	Red	One or more hardware errors detected on the module.
	Green	No hardware errors detected on the module.

SD input

The QPP-0002 has a (24 Vdc) emergency Shut Down input.

A low level on the emergency Shut Down input will de-energize the watchdog outputs independently from the processor. The SD input is available on the Controller backplane and requires a normally closed (field-)contact.

The SD input is common for both Control Processors. The +24 V_SD-output is supplied by both QPP-0002 modules, but the input stays operational even if one of the QPP-0002 modules has no 24 Vdc supply, or is removed.

- If the SD function is used you should connect an external potential free SD contact via the SICP-0002/L3 (see “SICP-0002/L3” on page 722).
- If the SD function is not used an SD link is required (default placed on the CP backplane).

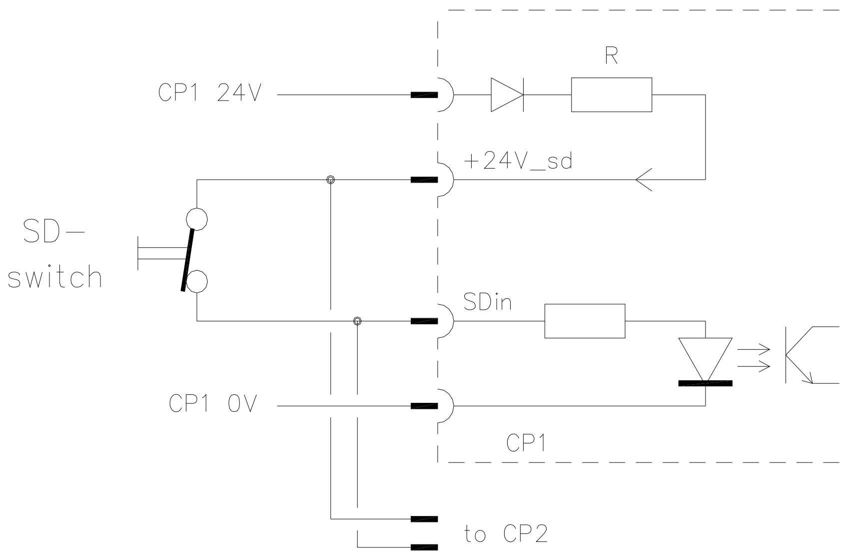
This SD input is 24 Vdc and galvanically isolated from the internal 5 Vdc (see Figure 158 on page 260).

Note:

The resistor R on the 24 V input circuit of the SD input in Figure 158 on page 260 limits the short-circuit current (to 0 V) of the +24 V_sd signal.

The external potential free SD switch is connected via a SICP-0002/L3 cable. For more details see "SICP-0002/L3" on page 722 and "CPCHAS-0001" on page 87.

Figure 158 SD input schematic



Watchdog functionality

The Watchdog function in the QPP-0002 monitors the operation and the operating condition of the processors. The processor operation is monitored by verifying whether the processors execute all the tasks within a pre-calculated time frame, which depends on the configuration. The monitored operating conditions include the data integrity of the processor memory, the (5 V) processor supply voltage and the (24 V) IO supply voltage (both undervoltage and overvoltage). If the Watchdog detects a fault in the operation of the QPP-0002 or its operating conditions, it will deactivate its outputs and thus deactivates the safety-critical outputs of Safety Manager, independent of the QPP-0002 status.

The watchdog module monitors system parameters including:

- The application loop maximum execution time. This in order to detect if the process is executing its program correctly and is not looping (hang-up).
- The application loop minimum execution time. This in order to detect if the processor is executing its program correctly and is not skipping program parts.
- Data (-bus) differences. This will detect memory errors and processor defects.
- 5 Vdc level. Overvoltage and undervoltage detection (5 Vdc ± 5%).
- 24 Vdc level. Overvoltage and undervoltage detection (24 Vdc –20%, +35%).
- SD input signal level.

The watchdog also includes the following features:

- A 1oo2D functionality.
  The processor has the capability to de-energize the watchdog of the other (redundant) processor in the Controller chassis.
- A (second) watchdog-output for the non-redundant IO modules.
  This output is connected in parallel with the (second) output of the other processor in the Controller chassis. The output is used to energize the watchdog input of non-redundant IO chassis and will stay ‘high’ as long as at least one of the processors keeps its (second) output high. If a fault is detected in a module in the non-redundant IO section, the processors can switch off this ‘second’ watchdog-output and keep the redundant IO modules online.

In order to be able to test all watchdog functions, the watchdog module is duplicated. The outputs are switched in parallel (‘wired OR’ function) to enable a trip of one section without losing the watchdog signal to the IO.

Figure 159 on page 262 and Figure 160 on page 263 show the watchdog section and watchdog outputs schematics.

Figure 159 Watchdog section schematic

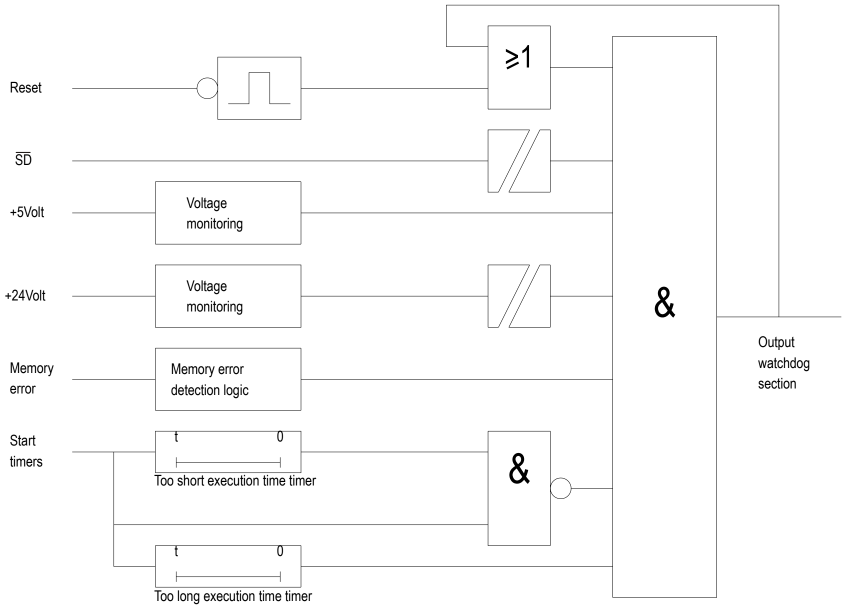
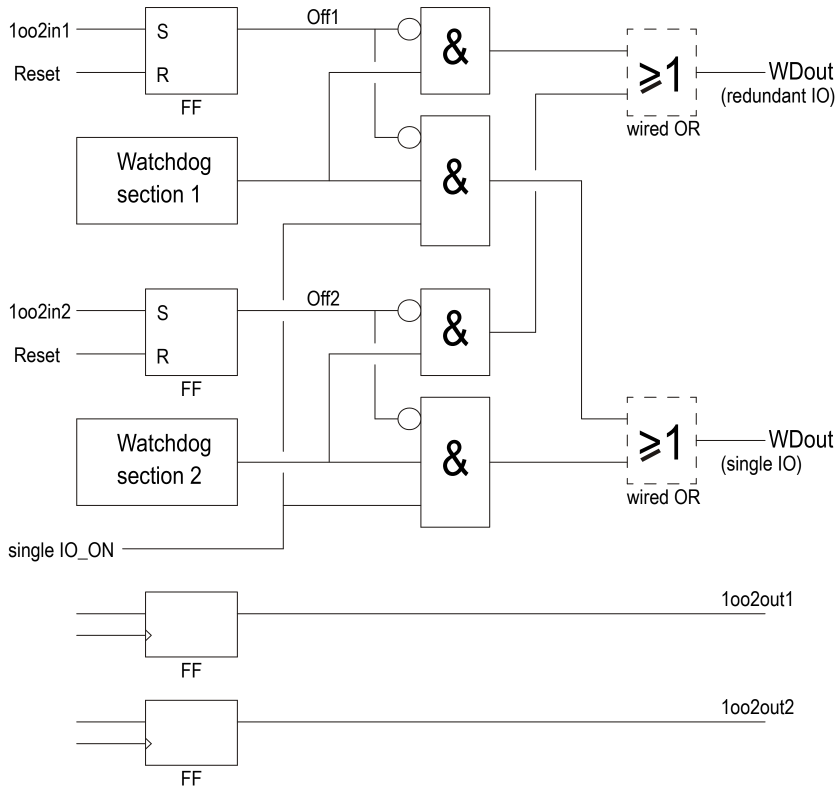


Figure 160 Watchdog outputs schematic



The lower two flip-flops in Figure 160 on page 263 latch the (outgoing 1oo2D) commands to de-energize the watchdog (parts) of the (redundant) processor. These outputs of the (redundant) processor are connected to the (1oo2D) inputs of this watchdog ('1oo2in1' and '1oo2in2' in Figure 160 on page 263).

Each WD_{out} output can drive 750mA.

Diagnostics

The following diagnostics are performed by the QPP-0002 module:

- QPP-0002 generates an alarm and event when battery voltage drops below the data retention voltage. The “data retention voltage” is defined as the absolute minimum voltage needed for a device to correctly maintain the contents of their RAM circuits. This voltage is standard 2.0 V.
- QPP-0002 generates an alarm and event when the battery lifetime expires.
- The 5 Vdc voltage ‘too high’ or ‘too low’ will be alarmed.
The 24 Vdc voltage ‘too high’ or ‘too low’ will be alarmed.
- The diagnostics on the hardware comparators will detect “stuck-at” and “shorts between inputs and outputs of the comparators”.
- The fault reaction to faults detected in the temperature monitoring function will result in an alarm, unless the temperature measured by the other Control Processor differs less then 3 degrees Celsius from a shutdown limit. In the latter case, an automatic shutdown of the Control Processor is initiated.
- Faults detected in the 10 ms base timer function result in automatic Control Processor shutdown.
- The fault reaction on a hardware failure detected by the hardware comparators of the application processor will result in an alarm to the safety processor, which initiates a Control Processor shutdown.

The following diagnostics are defined for the BKM-0001 (most electronics for execution of these functions are located on the QPP-0002):

- The BKM-0001 is not placed.
- Battery voltage is out of range (too high, too low and open circuit).
- The safety processor will have the capability and possibility to indicate a faulty battery status on the status LED of the BKM-0001.

Technical data

General	Type number[1]:	FC-QPP-0002 CC V1.0
	Operating temperature:	
	• outside module temperature:	–5°C—+70°C (+23°F—+158°F)
	• inside module temperature:	–5°C—+70°C (+23°F—+158°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Relative humidity:	10—95% (non condensing)
	Approvals:	CE, UL, CSA, TUV, FM
Power	24 V supply voltage:	24 Vdc –15%—+30%
	24 V supply current:	max. 25 mA
	5 V supply voltage:	5 Vdc ± 5%
	5 V supply current:	max 1.2 A
+24 V_sd	Output supply voltage:	15—31 Vdc
	Output resistance:	approx. 1.1 kΩ
	Short circuit proof:	continuous
SD input	Voltage (high):	15—32 Vdc
	Voltage (low):	<4 V (reverse polarity protected)
	Input current:	approx. 8mA at 24 Vdc
WD_{out} output	Output current:	750mA per output
Physical	Dimensions: (H × W× D)	176 × 88.5 × 212 mm 6.93 × 3.48 × 8.35 in
	Weight:	1,3 kg

1 FC-type modules are conformal coated modules.

USI-0001

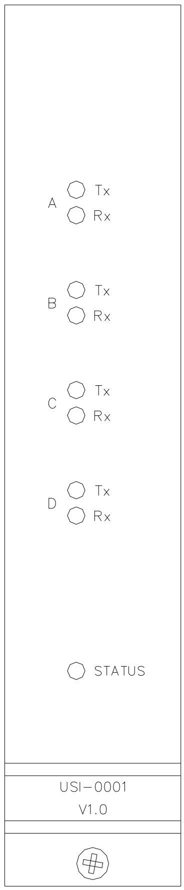
Universal Safety Interface

Description

The USI-0001 communication module handles Ethernet and Serial communication with external devices, e.g. Experion™ PKS and Safety Builder. It is located in the Controller chassis (see section "CPCHAS-0001" on page 87 or "CPCHAS-0002" on page 116).

Figure 161 on page 266 shows the front view of the USI-0001 module.

Figure 161 Front view of the USI-0001 module



The main function of communication modules is handling the communication to and from external devices and other Safety Managers. The USI-0001 has four (4) independent communication channels. See Table 43 on page 267 for the relevant details.

Table 43 The communication channels of the USI-0001 module

Channel	Description	Connector	Connects to	Communication cable
A	10/100 Mb Ethernet[1] Communication Channels	RJ45	UCOM-HSE	CCI-HSE-01
B				
C	General purpose Serial Communication Channels	10-pins AMP	DCOM-232/485	CCI-UNI-01
D				

1 The Ethernet interfaces are auto-ranging, they automatically select between 10 and 100 Mb.

Furthermore, the USI-0001 communication module acts as hardware firewall, protecting the safety functions within Safety Manager.

The module consists of the following items:

- A Motorola 8260 communication processor.
- EEPROM to store specific module data, such as the two MAC-addresses and the hardware revision number.
- 8 Mbyte Flash memory to store the system and application program. The flash content is copied to SRAM at startup and is executed from there. The flash content can be updated without removing the USI-0001 from the Controller chassis.
- 4 Mbyte Local SRAM (with Error Detecting and Correcting logic) for system and application program and information.
- 256 kilobyte shared RAM for data exchange between the USI-0001 and the Control Processor.
- Two dual-speed fast ethernet transceivers
- Two general purpose serial communication controller channels.

LED Indicators

Table 44 on page 268 lists LEDs that are visible at the front side of the USI-0001 module.

Table 44 LED indicators of the USI-0001 module

LED	Status	Description
Tx N[1]	Green	Data is being transmitted on channel N*.
	Off	No data is being transmitted on channel N*.
Rx N*	Green	Data is being received on channel N*.
	Off	No data is being received on channel N*.
STATUS	Green	No hardware errors are detected in the module.
	Red	One or more hardware errors are detected in the module.
	Off	Power down or booting

1 N = 1, 2, 3 or 4.

Reset mechanism

The USI-0001 module resets hardware via the following mechanisms:

- Power-up or power-dip.
- If the Quad Processor Pack (key switch) goes in 'STOP' mode.
- If the Quad Processor Pack generates a COMmunication RESet.

The communication *channels* are reset (go offline) if:

- the module resets, or
- the dedicated watchdog times out.

Note:

A dedicated watchdog has been added to prevent a possible communication lock-out on the communication lines, if the processor on the USI-0001 gets a fatal error (e.g. program hang-up or loss of clock).

Hot swap

The USI-0001 module has 'hot swap' features.

This means that the module may be placed or removed in a running system. The application program will not be interrupted by these actions.

Additional specifications

The USI-0001 module has a galvanic isolation of:

- ≥ 2.5 kVdc between the 5 Vdc and the Ethernet signal.
- ≥ 1.5 kVdc between the Ethernet signal and the casing of the USI-0001.
- ≥ 1.5 kVdc between the 5 Vdc and the casing of the USI-0001.

If a memory error in the USI-0001 module is detected, the Quad Processor Pack will get an interrupt.

The USI-0001 module has a power-up self-test (diagnostics) phase for testing of the following components:

- Processor address- and data registers
- Local RAM
- Shared RAM
- Exception Handling
- Software integrity

Power-up self-tests are required to reduce the risk of defective hardware or corrupted software being used.

Technical data

The USI-0001 has the following specifications.

General	Type numbers[1 2]:	FS-USI-0001 V1.2
		FC-USI-0001 CCV1.2
	Operating temperature:	–5°C — +70°C (+23°F — +158°F)
	Storage temperature:	–40°C — +85°C (–40°F — +185°F)
	Relative humidity:	10 — 95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	5 V supply voltage:	5 Vdc ±5%
	5 V supply current:	max 1.2A
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D) 6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0.7 kg

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved design. Modules with suffix code V1.2 or CCV1.2 or higher have an improved ethernet request handle.

USI-0002

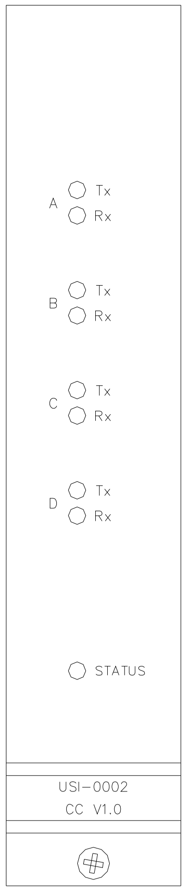
Universal Safety Interface

Description

The USI-0002 communication module handles Ethernet and Serial communication with external devices, e.g. Experion™ PKS and Safety Builder. It is located in the Controller chassis (see section “CPCHAS-0001” on page 87 or “CPCHAS-0002” on page 116).

Figure 162 on page 271 shows the front view of the USI-0002 module.

Figure 162 Front view of the USI-0002 module



The main function of communication modules is handling the communication to and from external devices and other Safety Managers. The USI-0002 has four (4) independent communication channels. See Table 45 on page 272 for the relevant details.

Table 45 The communication channels of the USI-0002 module

Channel	Description	Connector	Connects to	Communication cable
A	10/100 Mb Ethernet[1] Communication Channels	RJ45	UCOM-HSE	CCI-HSE-01
B				
C	General purpose Serial Communication Channels	10-pins AMP	DCOM-232/485	CCI-UNI-01
D				

1 The Ethernet interfaces are auto-ranging, they automatically select between 10 and 100 Mb.

Furthermore, the USI-0002 communication module acts as hardware firewall, protecting the safety functions within Safety Manager. It has:

- enhanced protective capablity,
- more internal memory; this makes it suitable for running multiple demanding communication protocols in parallel.

The module consists of the following items:

- A Motorola 8260 communication processor.
- EEPROM to store specific module data, such as the two MAC-addresses and the hardware revision number.
- 8 Mbyte Flash memory to store the system and application program. The flash content is copied to SRAM at startup and is executed from there. The flash content can be updated without removing the USI-0002 from the Controller chassis.
- 8 Mbyte Local SRAM (with Error Detecting and Correcting logic) for system and application program and information.
- 256 kilobyte shared RAM for data exchange between the USI-0002 and the Control Processor.
- Two dual-speed fast ethernet transceivers
- Two general purpose serial communication controller channels.

LED Indicators

Table 46 on page 273 lists LEDs that are visible at the front side of the USI-0002 module.

Table 46 LED indicators of the USI-0002 module

LED	Status	Description
Tx N[1]	Green	Data is being transmitted on channel N[*].
	Off	No data is being transmitted on channel N[*].
Rx N[*]	Green	Data is being received on channel N[*].
	Off	No data is being received on channel N[*].
STATUS	Green	No hardware errors are detected in the module.
	Red	One or more hardware errors are detected in the module.
	Off	Power down or booting

1 N = 1, 2, 3 or 4.

Reset mechanism

The USI-0002 module resets hardware via the following mechanisms:

- Power-up or power-dip.
- If the Quad Processor Pack (key switch) goes in ‘STOP’ mode.
- If the Quad Processor Pack generates a COMmunication RESet.

The communication *channels* are reset (go offline) if:

- the module resets, or
- the dedicated watchdog times out.

Note:

A dedicated watchdog has been added to prevent a possible communication lock-out on the communication lines, if the processor on the USI-0002 gets a fatal error (e.g. program hang-up or loss of clock).

Hot swap

The USI-0002 module has ‘hot swap’ features.

This means that the module may be placed or removed in a running system. The application program will not be interrupted by these actions.

Additional specifications

The USI-0002 module has a galvanic isolation of:

- ≥ 2.5 kVdc between the 5 Vdc and the Ethernet signal.
- ≥ 1.5 kVdc between the Ethernet signal and the casing of the USI-0002.
- ≥ 1.5 kVdc between the 5 Vdc and the casing of the USI-0002.

If a memory error in the USI-0002 module is detected, the Quad Processor Pack will get an interrupt.

The USI-0002 module has a power-up self-test (diagnostics) phase for testing of the following components:

- Processor address- and data registers
- Local RAM
- Shared RAM
- Exception Handling
- Software integrity

Power-up self-tests are required to reduce the risk of defective hardware or corrupted software being used.

Technical data

The USI-0002 has the following specifications.

General	Type numbers:	FC-USI-0002 V1.0
	Operating temperature:	–5°C — +70°C (+23°F — +158°F)
	Storage temperature:	–40°C — +85°C (–40°F — +185°F)
	Relative humidity:	10 — 95% (non condensing)
	Approvals:	CE; TUV, UL, CSA, FM pending
Power	5 V supply voltage:	5 Vdc ±5%
	5 V supply current:	max 1.2A
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D) 6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0.7 kg

BLIND-COM

Dummy communication module

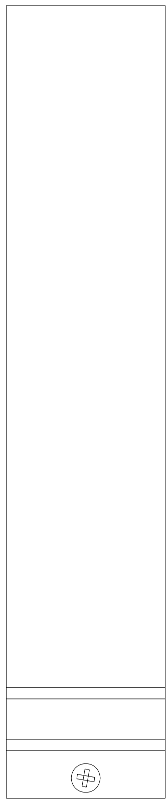
Description

The dummy communication module (BLIND-COM) is placed in COM slots of the Controller chassis that are not used for actual communication modules (module USI-0001 or USI-0002).

The purpose of this module is to create a closed and grounded EMC-shield at the front of the Controller chassis.

Figure 163 on page 275 shows the front view of the BLIND-COM.

Figure 163 Front view of the BLIND-COM



Technical data

The BLIND-COM has the following specifications:

General	Type number:	FS-BLIND-COM V1.0
	Operating temperature:	–40°C—+85°C (–40°F—+185°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
Power	None	
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D) 6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0,5 kg

BKM-0001

Battery and Key switch Module

Description

The Battery and Key switch Module (BKM-0001) is located in the Controller chassis (see section “CPCHAS-0001” on page 87 or “CPCHAS-0001” on page 87 or “CPCHAS-0002” on page 116).

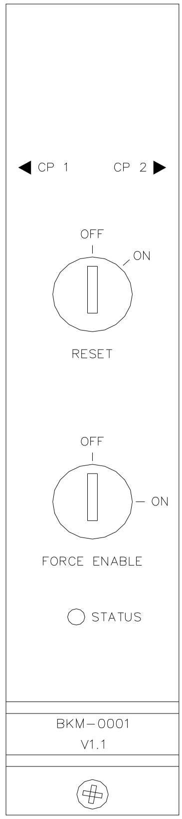
There is only one BKM-0001, even in a redundant Controller chassis.

The BKM-0001 contains the following items:

- Two batteries (one for each Control Processor)
- Force Enable key switch
- Reset key switch
- Three (24 Vdc) general purpose inputs (IN1, IN2, IN3) located on the Controller backplane, see “Controller backplane CPB-0001” on page 91).

Figure 164 on page 278 shows the front view of the BKM-0001 module.

Figure 164 The front view of the BKM-0001 module



The BKM-0001 module may be placed or removed in a running system. The application program will not be interrupted by these actions.

Attention

Removal of the BKM-0001 module should only be done with its Force Enable key switch in the 'OFF' position. Extraction of the BKM-0001 module will always remove all forces.

Batteries

The BKM-0001 module contains non-rechargeable (lithium) batteries that supply the back-up power to maintain the diagnostic messages and the real time clock on the QPP modules, in case of a power outage.

As the batteries are not recharged, the used back-up time is accumulating. *The total back-up time of the lithium cells is approximately 3 months*.

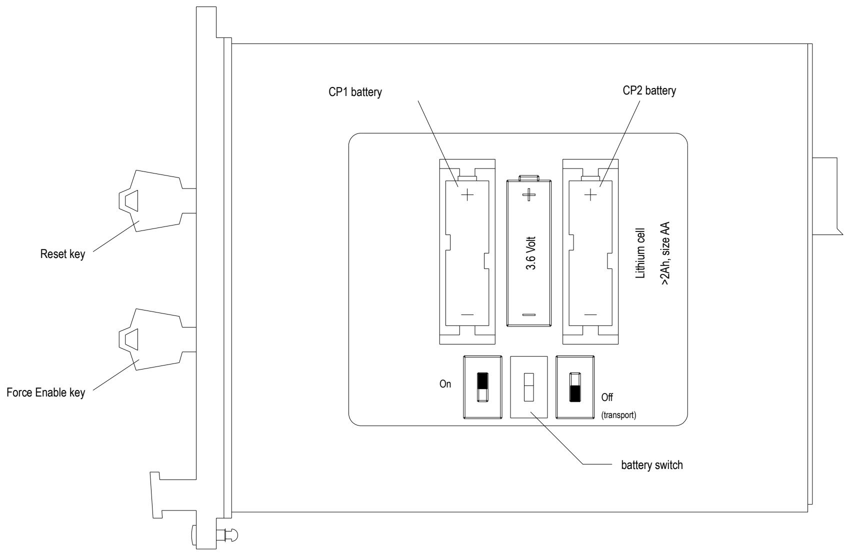
If the system is switched off for a longer period (and during transport), the batteries can be switched off with the battery switch on the module.

It is recommended to replace the batteries every five years and after every substantial discharge period.

Replacing the batteries requires no special tools.

The side plate of the BKM-0001 module has an opening to enable battery replacement and battery-switch operation (see Figure 165 on page 279).

Figure 165 Side view of the BKM-0001



When the batteries are disconnected (battery switch in the OFF position) the status LED will stay red.

Reset key switch

The Reset key switch is used for emptying the diagnostics database and resetting (starting) the watchdog. Its default position is the **OFF** position, to which it will automatically return after setting it in the **ON** position. You can only remove the key in the **OFF** (vertical) position.

The key required for the Reset key switch is a different key than the one for the Force Enable key switch.

Reset key switch state	Function
OFF	No action
ON	• The Watchdog signal is reset for both Control Processors. • The fault database (diagnostics database) is cleared for both Control Processors.

Force Enable key switch

The Force Enable key switch is used for enabling or disabling software-controlled forcing of input and output signals. The key is removable in both positions.

The key required for the Force Enable key switch is a different key than the one for the Reset key switch.

Force Enable key switch state	Function
OFF	Software-controlled forcing of input and output signals is **not** possible. All active forces are removed.
ON	Software-controlled forcing of input and output signals is possible.

Status LED

Table 47 on page 280 lists the possible LED status indications that are visible at the front side of the BKM-0001 module.

Table 47 LED indicators of the BKM-0001 module

LED	Status	Description
STATUS	Off	The power to the module is down.
	Red	The battery switch is in OFF position. One (or both) battery voltage(s) are too low (or fuse is blown)
	Green	No battery error is detected.

Additional functionality

The diagnostics for the BKM-0001 include:

- BKM-0001 not placed.
- Battery voltage out of ranges (too high, too low and open circuit).

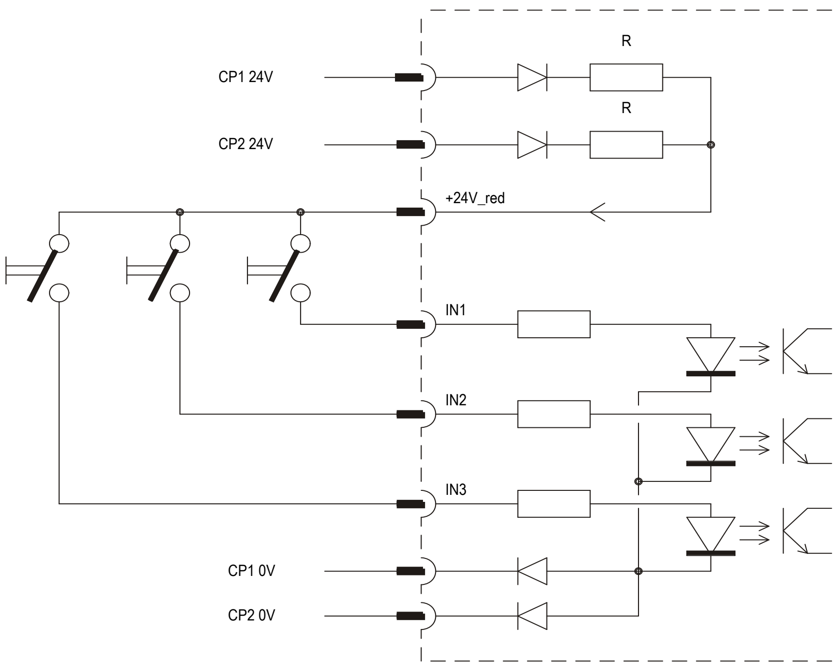
The BKM-0001 module has a 24V output circuit to power its three general purpose (24 Vdc) inputs (see Figure 166 on page 281). The inputs require a contact in the field and will stay operational even if the 24 Vdc of one of the Control Processors is switched off.

Note:

The resistors R on the 24V input circuit in Figure 166 on page 281 limit the short-circuit current (to 0 V) of the +24V_red signal.

The external potential free switches on IN1, IN2 and IN3 are connected using SICP-0002/L3 cables. For more details see “SICP-0002/L3” on page 722, and “CPCHAS-0001” on page 87 or “CPCHAS-0001” on page 87 or “CPCHAS-0002” on page 116.

Figure 166 24 V input circuits on the BKM-0001 module



Technical data

The BKM-0001 has the following specifications:

General	Type numbers[1]:	FS-BKM-0001 V1.1[2]
		FC-BKM-0001 CCV1.1
	Operating temperature:	–5°C—+70°C (+23°F—+158°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Relative humidity:	10—95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	24 V supply voltage:	24 Vdc –15%—+30%
	24 V supply current:	max. 20 mA (out of each 24 Vdc) typ. 7 mA (shared load on 24 Vdc)
	5 VR supply voltage:	5 Vdc ± 10%
	5 VR supply current:	max. 10 mA
+24V_red	Output supply voltage:	14—31 Vdc
	Output resistance:	approx. 2 × 1.1 kΩ (parallel)
	Short circuit proof:	continuous
Input	Voltage (high):	14—35 Vdc
	Voltage (low):	< 7 Vdc (reverse polarity protected)
	Input current:	2.3 mA at 24 Vdc
	Input filter (IN1):	typ. 0.1 ms
	Input filter (IN2 & IN3):	typ. 10 ms
Battery	Make:	SAFT
	Type[3]:	LS14500CGFG (recommended)
		LS14500W (alternative)
	Material:	Lithium Thionyl Chloride
	Voltage:	nominal 3.6 V
	Capacity:	> 2 Ah
	Size:	AA
	Operating temperature:	–40°C—+85°C (–40°F—+185°F)
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D) 6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	500 g

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Version 1.0 modules have a darker blue front plate.

3 Use of specified make and type numbers is necessary to maintain UL approval.

PSU-240516

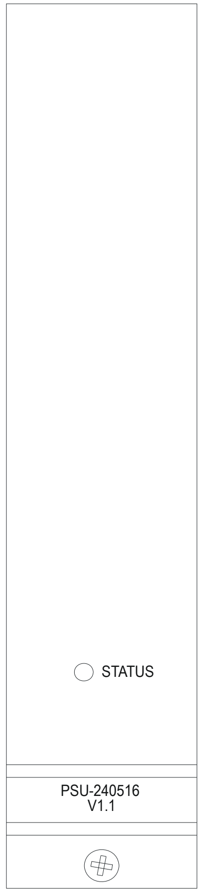
Power Supply Unit 24/5 Vdc, 16 A

Description

The PSU-240516 power supply unit converts incoming 24 Vdc to (local) 5 Vdc and (redundant) 5 Vdc, and is located in the Controller chassis (see “CPCHAS-0001” on page 87 or “CPCHAS-0001” on page 87 or “CPCHAS-0002” on page 116).

Figure 167 on page 285 shows the front view of the PSU-240516 module.

Figure 167 Front view of the PSU-240516 module

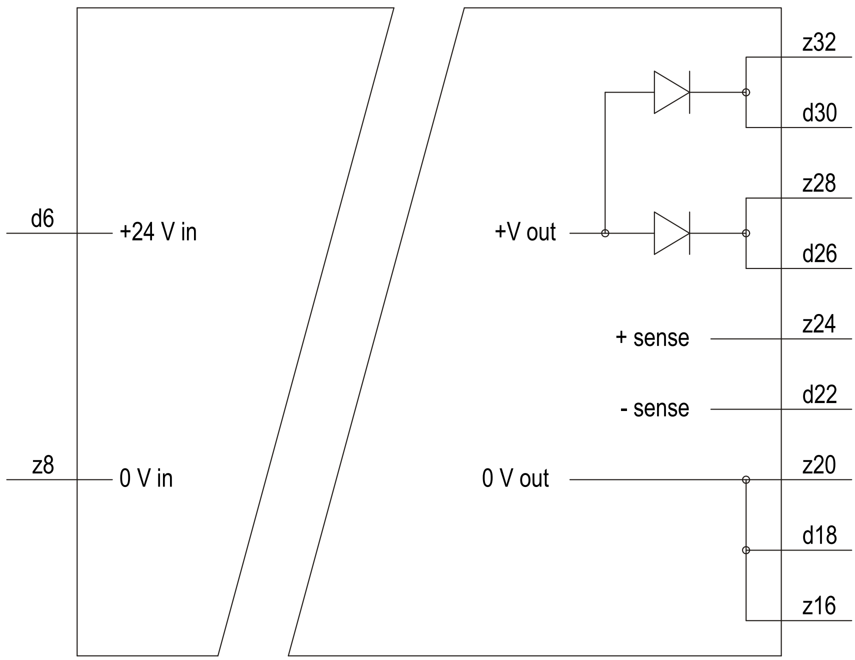


The (local) 5 Vdc output (5V1 resp. 5V2) supplies 5 V to its Control Processor and the redundant IO modules of its Control Processor. The (redundant) 5 Vdc output (5VR) shares the 5 V load of the non-redundant IO modules with the PSU-240516 of the other Control Processor. All 5 V supply signals are available on the WdPx connectors of the Controller backplane.

The PSU-240516 module has two independent overvoltage protection circuits. This makes the module suitable for safe applications without maintenance checks on regular intervals.

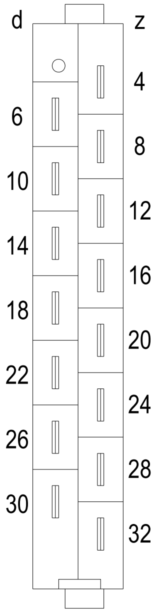
Figure 168 on page 286 shows a schematic diagram of the PSU-240516.

Figure 168 Schematic diagram of the PSU-240516



Pin allocation

The back view and pin allocation of the PSU-240516 module are as follows:



z4 Earth

d6 Supply 24 Vdc in

z8 Supply 0 Vdc in

d10

z12

d14

z16 Supply 0 Vdc out

d18 Supply 0 Vdc out

z20 Supply 0 Vdc out

d22 - sense

z24 + sense

d26 Supply 5 Vdc out (5Vx)

z28 Supply 5 Vdc out (5Vx)

d30 Supply 5 Vdc out (5VR)

z32 Supply 5 Vdc out (5VR)

Status LED

Table 48 on page 287 lists the possible LED status indications that are visible at the front side of the PSU-240516 module.

Table 48 LED indicators of the PSU-240516 module

LED	Status	Description
STATUS	Off	The (24 Vdc) power on the module is down or too low.
	Red	The 5 Vdc output level is too low.
	Green	The 5 Vdc output level is within range.

Additional functionality

The PSU-240516 module has a galvanic isolation of:

- ≥ 2.5 kVdc between the 24 Vdc input and the 5 Vdc outputs.
- ≥ 1 kVdc between the 24 Vdc and the casing of the PSU-240516.
- ≥ 1.5 kVdc between the 5 Vdc outputs and the casing of the PSU-240516.

Technical data

The PSU-240516 has the following specifications.

General	Type number[1 2]:	FS-PSU-240516 V1.1 FC-PSU-240516 V1.1
	Operating temperature:	–5°C—+70°C (+23°F—+158°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Relative humidity:	10—95% (non condensing)
	Approvals:	CE, TUV, UL, CSA, FM
Power	24 V supply voltage:	24 Vdc –15%—+30%
	24 V supply current:	< 6 A at 24 Vin (16 A load) < 7 A at 20.4 Vin (16 A load)
	Inrush current:	< 5 A at 24 Vin
	5 V_load:	min. 0.5 A max. 16 A
	5 VR_load:	max. (16 A—5V_load)
	Hold-up time:	< 1ms
Physical	Dimensions:	176 × 35.2 × 212 mm (H × W × D) 6.93 × 1.4 × 8.35 in (H × W × D)
	Weight:	0,85 kg

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 contain modified components. There are no functional changes.

Input modules

8

This chapter describes the input modules that are available for Safety Manager.

The following input modules are described:

input module		see
SDI-1624	Safe digital input module (24 Vdc, 16 channels)	page 293
SDI-1648	Safe digital input module (48 Vdc, 16 channels)	page 298
SAI-0410	Safe analog input module (4 channels)	page 303
SAI-1620m	Safe high-density analog input module (16 channels)	page 309
SDIL-1608	Safe loop-monitored digital input module with earth fault monitor (16 channels)	page 313

For related input converter modules, see "Input converter modules" on page 321.

For related FTAs, see "Field Termination Assembly modules" on page 499.

General info about input modules

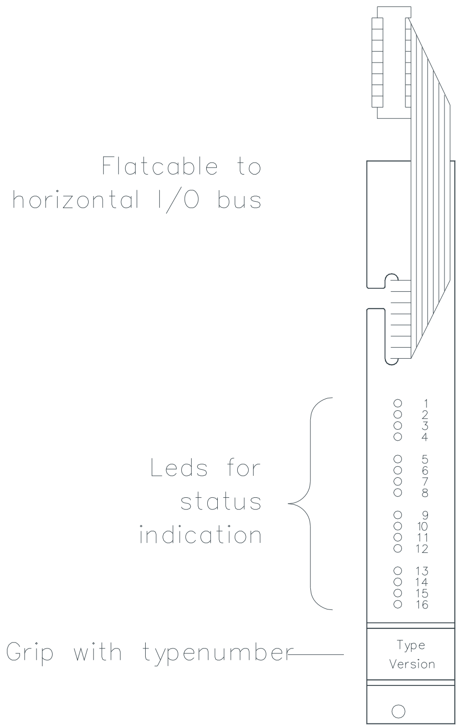
General

All input modules are standard European size (100 × 160 mm) instrument modules. The width of the module front is 4 TE = 4 HP (20.32 mm, 0.8 in), which is one slot in a standard 19 inch IO chassis.

Each input module is connected to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) via a flatcable, which extends from the module front.

Digital input modules have status LEDs for each input channel. The LEDs are located in the module front, below the flat cable.

Figure 169 Front of a digital input module



There are digital input modules for 24 Vdc, 48 Vdc and Namur signals. The modules are powered with 5 Vdc for circuits associated with the horizontal bus logic, and with 24 Vdc or 48 Vdc for the circuits associated with the input signals.

There are analog inputs for 0—20 mA, 0—5 V and 0—10 V field signals. These field signals can be converted to the required input voltage of the input modules (such as 0—2 V or 0—4 V) by using an FTA or an input converter module.

Input Modules

Input modules have galvanic isolation between 5 Vdc circuitry and field inputs. They are fitted with a male connector according to DIN 41612, type F, with the d, (b) and z rows in use.

The following items terminate on the chassis connector:

- 5 Vdc internal power supply
- 24 Vdc or 48 Vdc internal power supply
- 24 Vdc or 48 Vdc external power supply (if needed)
- Wiring for the input signals

The 5 Vdc signals are physically separated from the IO connections and supply.

The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 Vdc: +25% / –15%
- 48 Vdc: +15% / –15%
- 24 Vdc: +30% / –15%

Notes:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the SM Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the SM Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

Address

The address of an input module is determined by the modules slot in the IO chassis. This means that input modules have no jumpers or switches for setting the address. Each input module can be replaced by any module of the same type.

Replacing an input module

Input modules can be replaced with power switched on. Depending on the input signal function and the system IO configuration, process operation may be affected.

When removing an input module, first disconnect the flat cable from the horizontal IO bus (IOBUS-HBS or IOBUS-HBR), loosen the screws, and carefully slide the module out of the chassis.

When placing an input module into the chassis, carefully push it into the slot until it is flush with the chassis, fasten the screws, then connect the flatcable to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR).

SDI-1624

Safe digital input module (24 Vdc, 16 channels)

Description

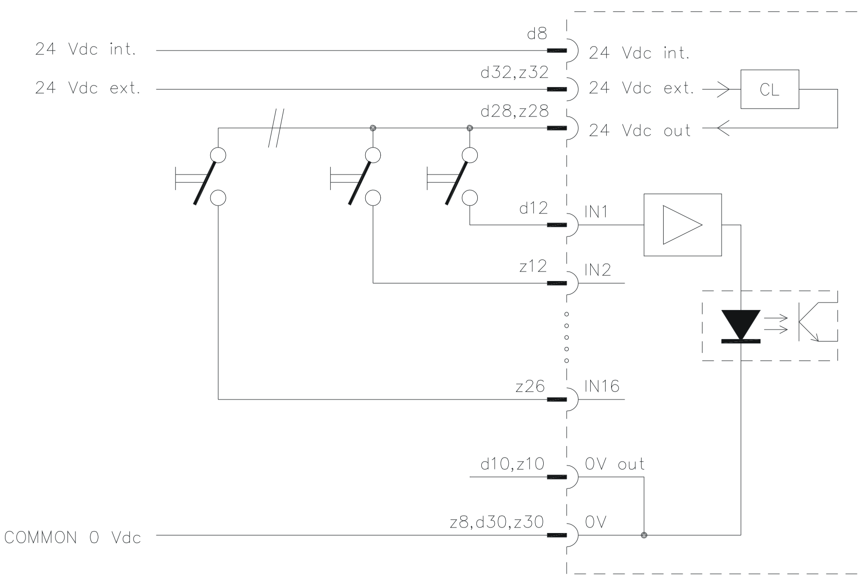
The safe digital input module SDI-1624 has sixteen 24 Vdc digital input channels. The input stage of the module is of a 'fail-to-safe' nature. This means that a component failure results in a de-energized input signal to the processor, which is the safe condition in a normally energized system.

The remaining logic circuitry on the module is completely covered by the self-test functions of the system. Within the configured Diagnostic Test Interval, the modules are tested for:

- Ability to receive logic level '0' signals
- Ability to receive logic level '1' signals
- Crosstalk between inputs

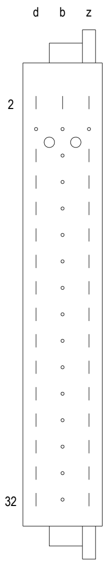
The 24 Vdc out pin is a current limited output, intended for energizing the (redundant) inputs via a field contact.

Figure 170 Schematic diagram for connection of inputs to the SDI-1624 module



Pin allocation

The following overview contains the back view and pin allocation of the SDI-1624 module connector:



d2		b2	GND	z2	5 Vdc
d4	–			z4	–
d6				z6	
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10	0 Vdc out			z10	0 Vdc out
d12	IN 1			z12	IN 2
d14	IN 3			z14	IN 4
d16	IN 5			z16	IN 6
d18	IN 7			z18	IN 8
d20	IN 9			z20	IN 10
d22	IN 11			z22	IN 12
d24	IN 13			z24	IN 14
d26	IN 15			z26	IN 16
d28	24 Vdc ext. out			z28	24 Vdc ext. out
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc ext.			z32	Supply 24 Vdc ext.

Connection examples

The figures below show a number of connection examples for the safe digital input module SDI-1624.

Note

The 24 Vdc (internal) supply must be connected to prevent fault detection during self-test.

Figure 171 Connection example of SDI-1624 module to FTA for both non-redundant and redundant IO configurations

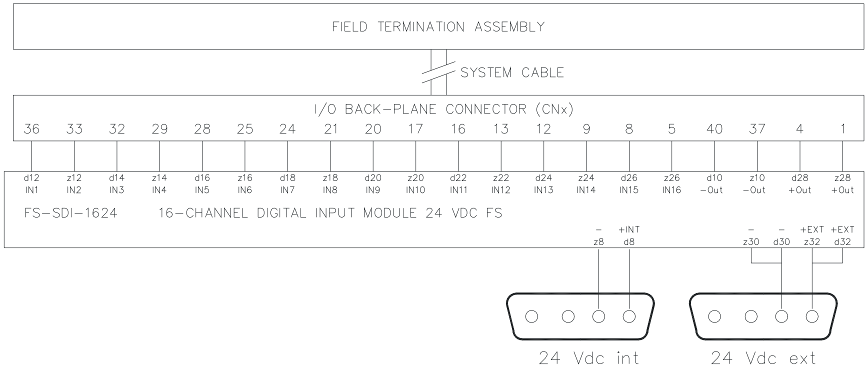


Figure 172 IO connection example of SDI-1624 module for non-redundant IO configurations

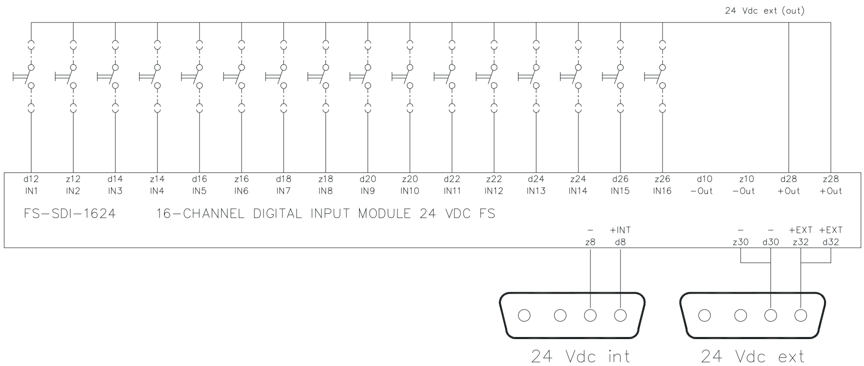
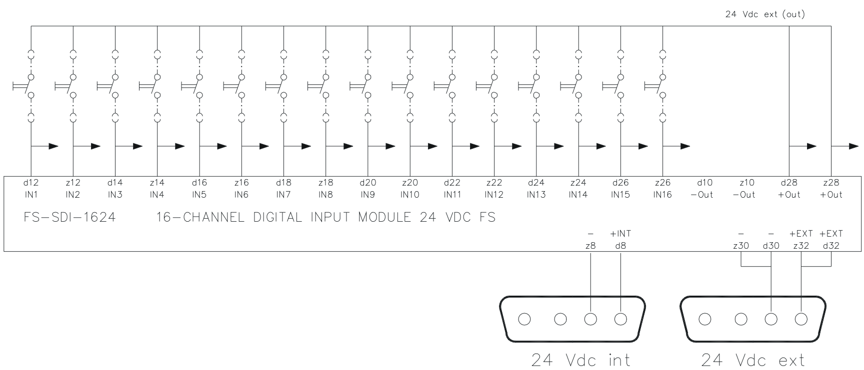


Figure 173 IO connection example of SDI-1624 module for redundant IO configurations



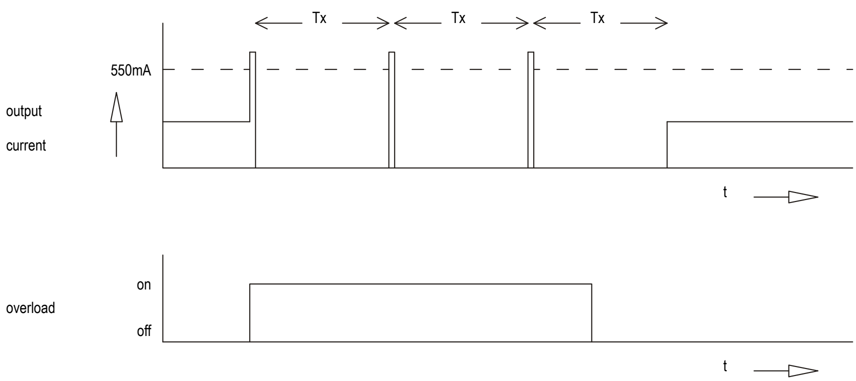
Hazardous locations (FM 3611)

The SDI-1624 module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see the FM Approval Guide EP-SM.6287.

24 Vdc Output current limiting

The 24 Vdc Out provides power to the switching elements. This transistor output has an electronic current-limiting circuit. If the output is overloaded or shorted, it goes into current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum current. If the overload or short-circuit persists, the output switches off for several hundred milliseconds, and tries again.

Figure 174 24V output overload / short-circuit behavior



Technical data

The SDI-1624 module has the following specifications:

General	Type numbers[1]:	FS-SDI-1624 V1.0
		FC-SDI-1624 CCV1.0
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 8 mA 24 Vdc int., 110 mA 24 Vdc ext., 110 mA (input currents)
	Ripple content (on 5 Vdc):	< 0.5 Vp-p (0—360 Hz)
Input	Number of input channels:	16
	Maximum input voltage:	36 Vdc
	Input current:	7 mA at 24 Vdc
	Input HIGH:	> 15 Vdc
	Input LOW:	< 9 Vdc (I < 2 mA)
	Input delay:	Typically 10 ms
Output	Type	24 Vdc solid state, short circuit proof
	Maximum current	450 mA (see Figure 174 on page 296)
	Max. load capacitance	32 µF
	Voltage drop	< 1.5 V at 450 mA
Key coding	(See section “Key coding” on page 17)	
	Module connector code:	
	• Holes	A5, C5
	Chassis connector code:	
	• Large pins	A5, C5

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

SDI-1648

Safe digital input module (48 Vdc, 16 channels)

Description

The safe digital input module SDI-1648 has sixteen 48 Vdc digital input channels. The input stage of the module is of a ‘fail-to-safe’ nature. This means a component failure will result in a de-energized input signal to the processor, which is the safe condition in a normally energized system.

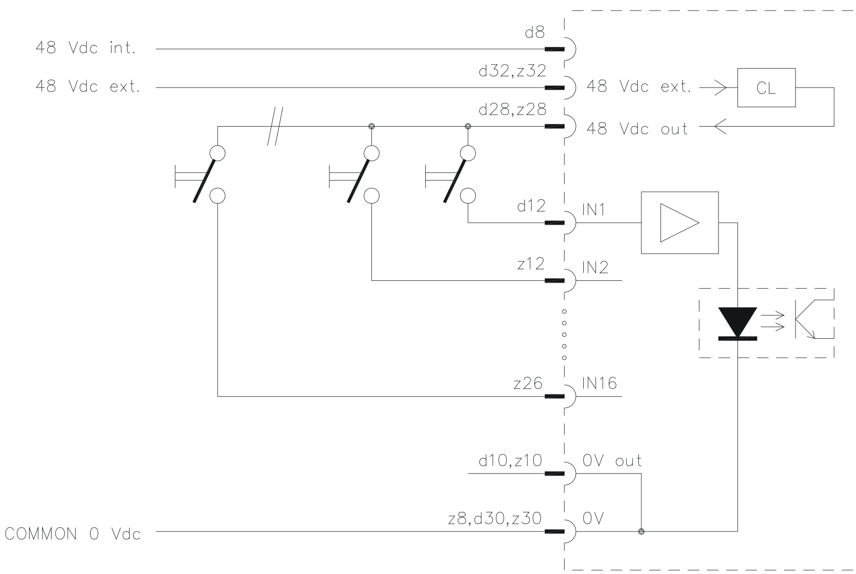
The remaining logic circuitry on the module is completely covered by the self-test functions of the system.

Within the configured Diagnostic Test Interval, the modules are tested for:

- Ability to receive logic level ‘0’ signals
- Ability to receive logic level ‘1’ signals
- Crosstalk between inputs

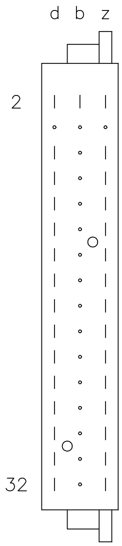
The 48 Vdc out pin is a current limited output intended for energizing the (redundant) inputs via a field contact.

Figure 175 Schematic diagram for connection of inputs to the SDI-1648 module



Pin allocation

The following overview contains the back view and pin allocation of the SDI-1648 module connector:



d2		b2	GND	z2	5 Vdc
d4	-			z4	-
d6				z6	
d8	Supply 48 Vdc int.			z8	Supply 0 Vdc
d10	0 Vdc out			z10	0 Vdc out
d12	IN 1			z12	IN 2
d14	IN 3			z14	IN 4
d16	IN 5			z16	IN 6
d18	IN 7			z18	IN 8
d20	IN 9			z20	IN 10
d22	IN 11			z22	IN 12
d24	IN 13			z24	IN 14
d26	IN 15			z26	IN 16
d28	48 Vdc ext. out			z28	48 Vdc ext. out
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 48 Vdc ext.			z32	Supply 48 Vdc ext.

Connection examples

The figures below show a number of examples of connections for the safe digital input module SDI-1648.

Figure 176 Connection example of SDI-1648 module to FTA for both non-redundant and redundant IO configurations

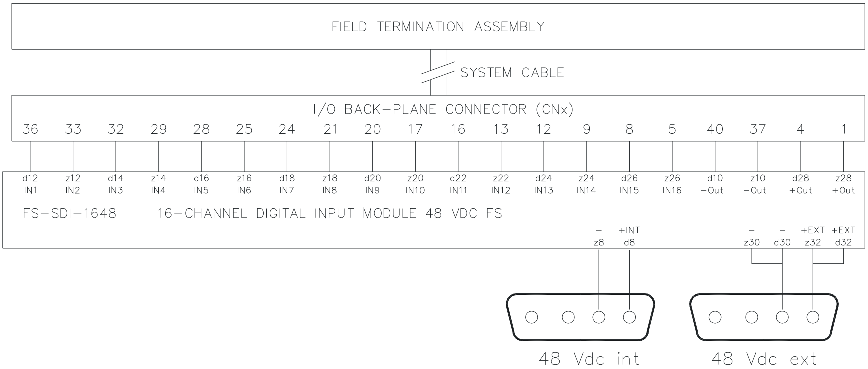


Figure 177 IO connection example of SDI-1648 module for non-redundant IO configurations

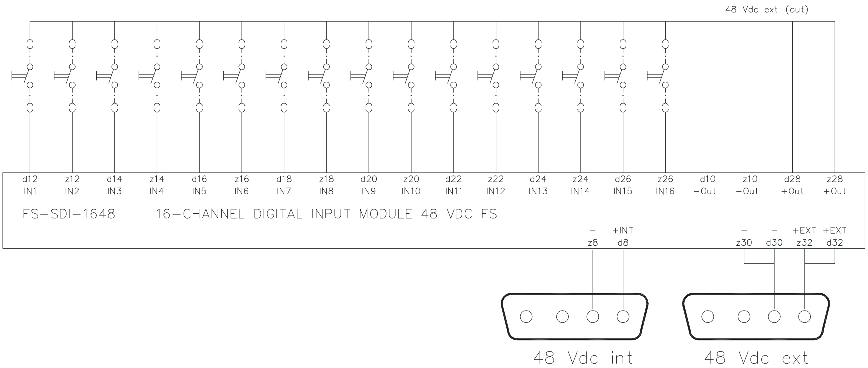
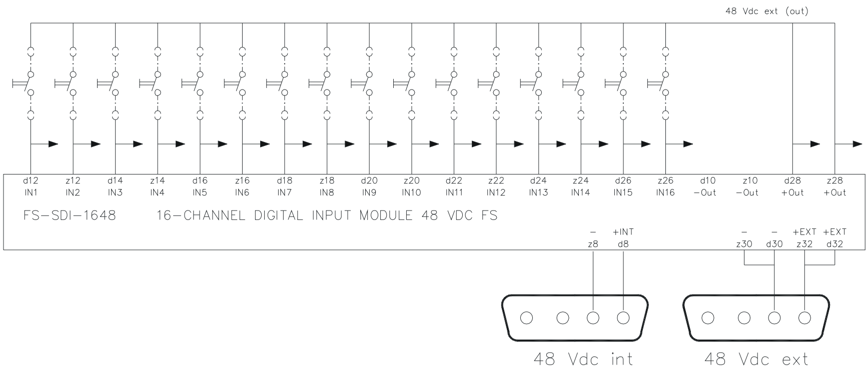


Figure 178 IO connection example of SDI-1648 module for redundant IO configurations



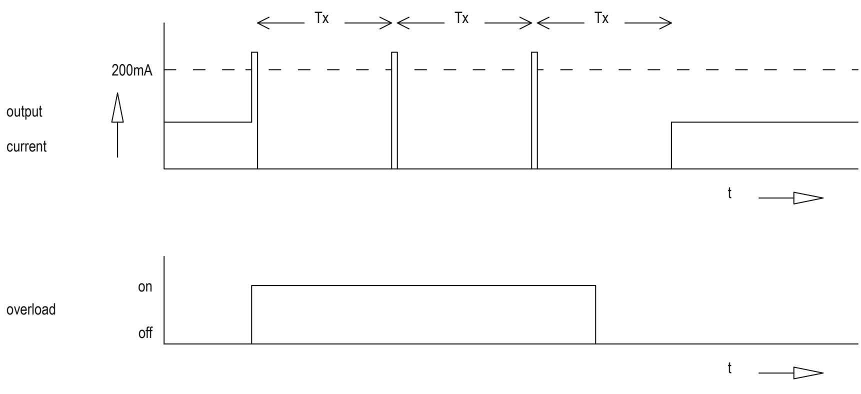
Note

The 48 Vdc (internal) supply must be connected to prevent fault detection during self-test.

48 Vdc output current limiting

The 48 Vdc Out provides power to the switching elements. This transistor output has an electronic current-limiting circuit. If the output is overloaded or shorted, it goes into current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum current. If the overload or short-circuit persists, the output switches off for several hundred milliseconds, and tries again.

Figure 179 48V output overload / short-circuit behavior



Technical data

The SDI-1648 module has the following specifications:

General	Type numbers[1 2]:	FS-SDI-1648 V1.1
		FC-SDI-1648 CCV1.1
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 8 mA 48 Vdc int., 45 mA 48 Vdc ext., 75 mA (input currents)
	Ripple content (on 5 Vdc):	< 0.5 Vp-p (0—360 Hz)
Input	Number of input channels:	16
	Maximum input voltage:	70 Vdc
	Input current:	4 mA at 48 Vdc
	Input HIGH:	> 30 Vdc
	Input LOW:	< 16 Vdc (I < 1.1 mA)
	Input delay:	typically 10 ms
Output	Type	48 Vdc solid state, short circuit proof
	Maximum current	200 mA (see Figure 179 on page 301)
	Max. load capacitance	20 μF
	Voltage drop	< 1.5 V at 200 mA
Key coding	(See section "Key coding" on page 17)	
	Module connector code:	
	• Holes	A13, C29
	Chassis connector code:	
	• Large pins	A13, C29

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved designed. There are no functional changes.

SAI-0410

Safe analog input module (4 channels)

Description

The safe analog input module SAI-0410 has four 0—2 V analog input channels. The analog inputs have a common 0 V connection, but are galvanically isolated from the 24 Vdc and 5 Vdc.

Analog inputs can be used either actively (with each input having a separate 26 Vdc > 20 mA short-circuit protected output) or passively (the supply being directly connected to the transmitter).

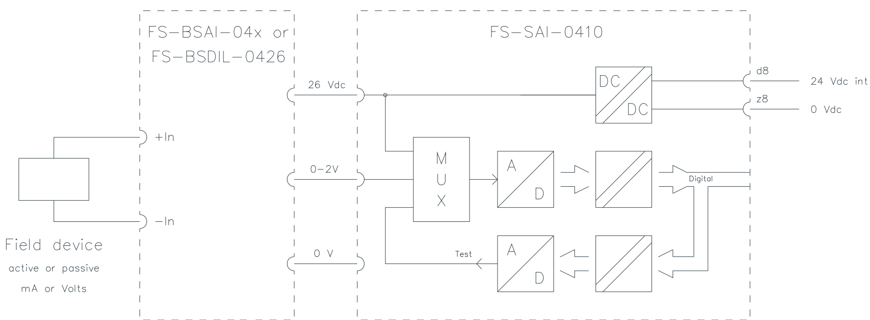
The SAI-0410 input stage has a high input impedance. It can therefore connect two SAI-0410 modules in parallel. The inputs require an analog input converter module BSAI-04x or BSDIL-0426 (see section "BSAI-04x + BSDIL-0426" on page 324).

Note

Inputs require an analog converter module (BSAI-04x or BSDIL-0426). The SAI-0410 module can therefore only be used in combination with an IO backplane in the chassis.

The analog input module scans analog inputs, 26 V output voltages, the internal supply voltages, and a reference voltage generated by a D/A converter. This D/A converter generates several reference voltages, which are used to test the analog input module completely. The self-test includes a leakage test of the input filter, as this could influence the accuracy of the analog input value.

Figure 180 Schematic diagram for connection of inputs to the SAI-0410 module



Within the configured Diagnostic Test Interval, the analog inputs are tested for:

- Absolute accuracy
- Correct conversion over full range
- Cross talk between inputs
- Output voltage of the 26 Vdc outputs

The 26 Vdc outputs are generated by the DC/DC converter and stabilized at 26 Vdc. They are therefore not affected by the voltage of the incoming 24 Vdc.

Note

The available output current is at least 21 mA. If the transmitters require a higher supply current, the input channels must be used in passive mode (= external supply).

Analog input ranges for Safety Manager

Table 49 on page 304 provides an overview of the analog input ranges for Safety Manager, and of the way SAI-0410 module can be used for each range.

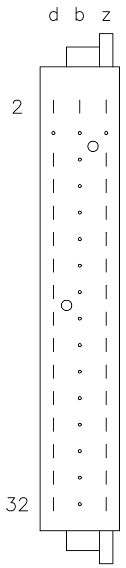
Table 49 Overview of analog inputs for Safety Manager

0(4)—20 mA	Internal power	SAI-0410 + BSAI-0420mI
0(4)—20 mA	External power	SAI-0410 + BSAI-0420mE
0(1)—5 V	External power	SAI-0410 + BSAI-0405E
0(2)—10 V	External power	SAI-0410 + BSAI-0410E
Loop-monitored digital input		SAI-0410 + BSDIL-0426

Other analog input signals, such as thermocouple or PT-100, can only be used after conversion to one of the analog input ranges that Safety Manager can handle.

Pin allocation

The following overview contains the back view and pin allocation of the SAI-0410 module connector:

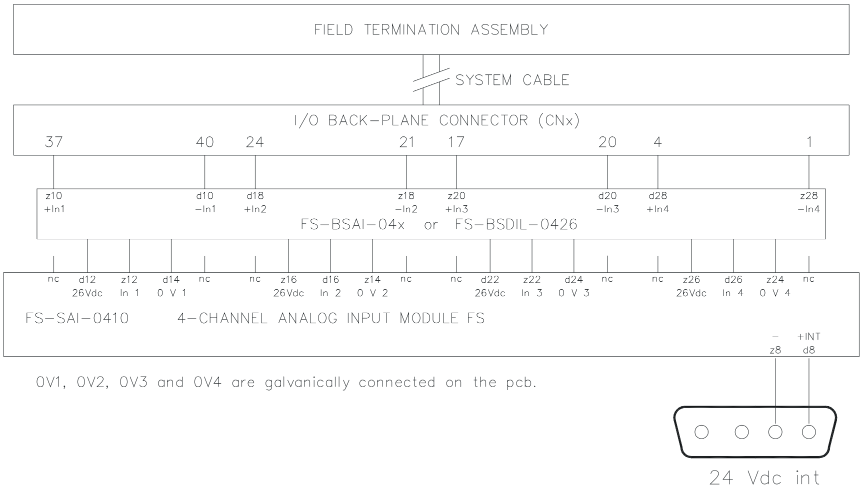


d2		b2	GND	z2	5 Vdc
d4	-			z4	-
d6				z6	
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10	(IN1-)			z10	(IN 1+)
d12	26 Vdc 1			z12	IN 1
d14	0 V 1			z14	0 V 2
d16	IN 2			z16	26 Vdc 2
d18	(IN 2+)			z18	(IN 2-)
d20	(IN 3-)			z20	(IN 3+)
d22	26 Vdc 3			z22	IN 3
d24	0 V 3			z24	0 V 4
d26	IN 4			z26	26 Vdc 4
d28	(IN 4+)			z28	(IN 4-)
d30				z30	
d32				z32	

Connection example

Figure 181 on page 306 shows a connection example for the SAI-0410 safe analog input module.

Figure 181 Connection example of SAI-0410 module to FTA for both non-redundant and redundant IO configurations



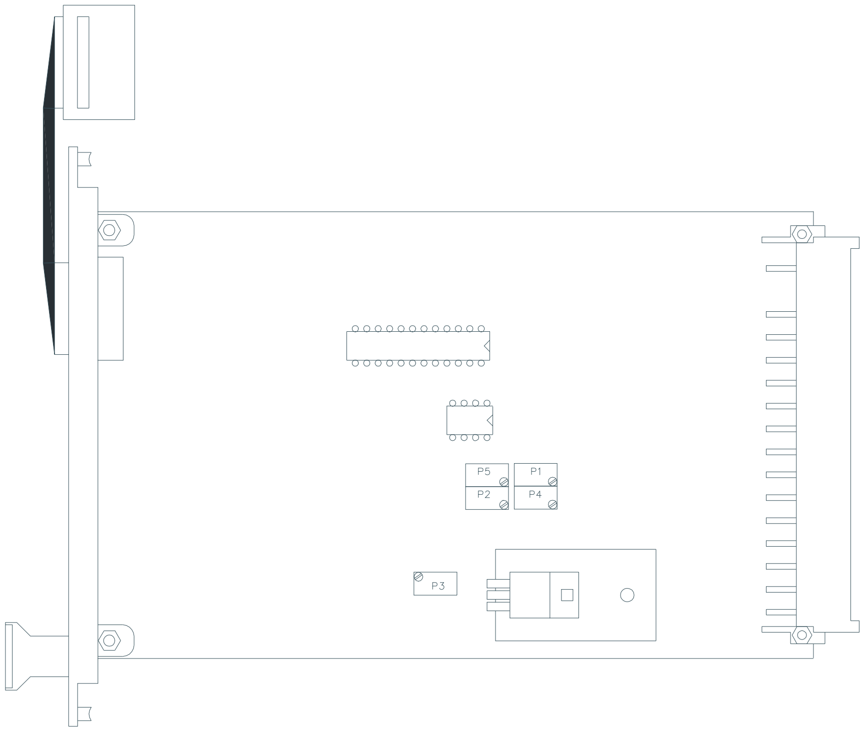
Hazardous locations (FM 3611)

The SAI-0410 module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see the FM Approval Guide EP-SM.6287.

Calibration

The SAI-0410 module has potentiometers for calibration purposes (P1, P2, P4, P5). To calibrate the module, you need to use the ‘View Safety Manager system and process status’ program, an external calibrator, an extender module and an extender flat cable.

Figure 182 Location of potentiometers on SAI-0410 module



Technical data

The SAI-0410 module has the following specifications:

General	Type numbers[1] :	FS-SAI-0410 V1.0
		FC-SAI-0410 CCV1.0
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 30 mA 24 Vdc, 175 mA +25 mA for each active input
Input	Number of input channels:	4
	Input specification (V):	0—2 Vdc
	Input resistance:	> 100 kΩ
	Loop powering:	26 Vdc (±1 V for 0.2 mA < I < 20 mA), short-circuit protected
	Loop current limit:	> 21 mA solid state
	A/D converter:	12-bit
	Inaccuracy:	≤ 0.75%
	Absolute max. input signal:	± 5 Vdc
Key coding	(See section “Key coding” on page 17)	
	Module connector code:	
	• Holes	A5, C17
	Chassis connector code:	
	• Large pins	A5, C17

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

SAI-1620m

Safe high-density analog input module (16 channels)

Description

The analog input module SAI-1620m has sixteen analog inputs (0—4 V) and an external voltage readback input (0—4 V). The sixteen channels are safe (safety class SIL3, in compliance with IEC 61508) and have an isolated analog 0 V common to all sixteen channels.

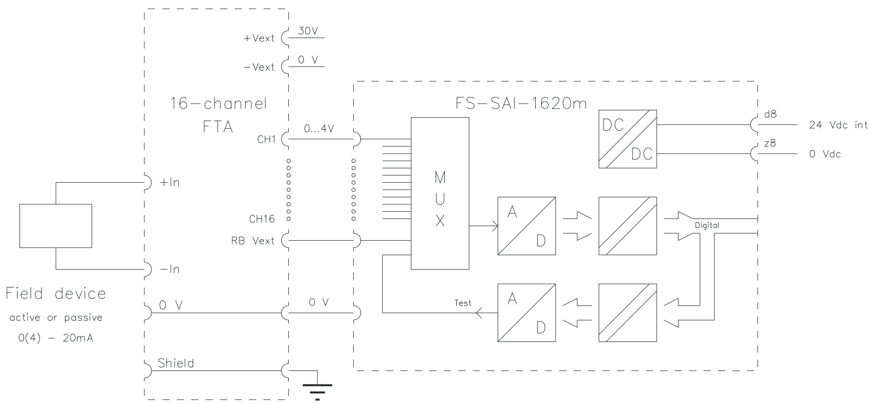
The field signals for the analog inputs of the SAI-1620m module need to be converted from 0—20 mA to a level suitable for the SAI-1620m module.

You can perform this conversion in two ways:

- On the field termination assembly module TSAI-1620m, TSHART-1620m, TSGAS-1624 or TSFIRE-1624
- Analog input conversion module BSAI-1620mE, located on programming connector (P_x) on the back of the IO backplane in the 19-inch chassis.

Analog input signals, such as thermocouple or PT-100, can only be used after conversion to 0(4)—20 mA with a dedicated converter (and an TSAI-1620m or BSAI-1620mE module).

Figure 183 Schematic diagram for connection of inputs to SAI-1620m module

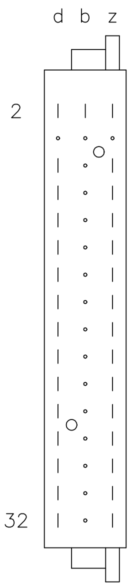


The self-test of the module, which is controlled by the SM Controller, checks:

- Absolute accuracy
- Correct conversion over the full range
- Crosstalk between inputs
- Channel input filters
- Internal supply voltages

Pin allocation

The following overview contains the back view and pin allocation of the SAI-1620m module connector:



d2		b2	GND	z2	5 Vdc
d4	-			z4	-
d6				z6	
d8	Int. 24 Vdc supply			z8	Int. 0 Vdc supply
d10	Analog ground			z10	Analog ground
d12	IN 1			z12	IN 2
d14	IN 3			z14	IN 4
d16	IN 5			z16	IN 6
d18	IN 7			z18	IN 8
d20	IN 9			z20	IN 10
d22	IN 11			z22	IN 12
d24	IN 13			z24	IN 14
d26	IN 15			z26	IN 16
d28	Analog ground			z28	Readback external power
d30				z30	
d32				z32	

Connection examples

Figure 184 on page 311 and Figure 185 on page 311 show typical connection examples for the SAI-1620m module.

Figure 184 Connection example of SAI-1620m module to FTA

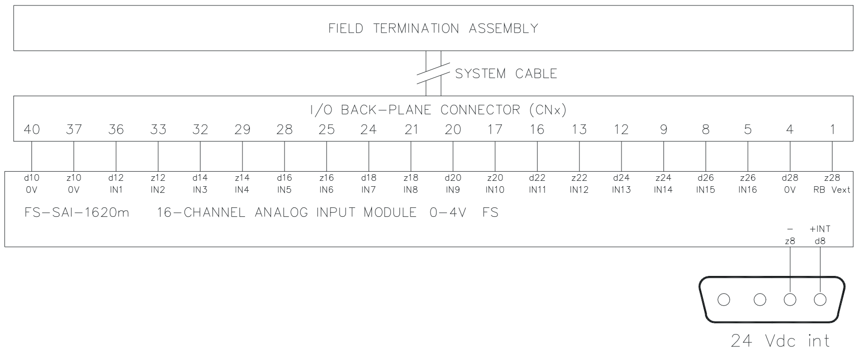
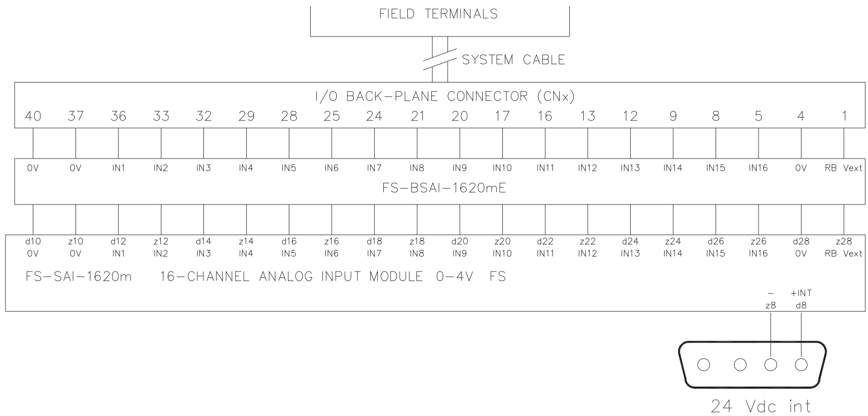


Figure 185 Connection example of SAI-1620m module with signal converter BSAI-1620mE



Hazardous locations (FM 3611)

The SAI-1620m module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see the FM Approval Guide EP-SM.6287.

Technical data

The SAI-1620m module has the following specifications:

General	Type numbers[1 2]:	FS-SAI-1620m V1.1
		FC-SAI-1620m CC V1.1
		FA-SAI-1620m CA V1.1
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 35 mA 24 Vdc, 35 mA
Input	Number of input channels:	16
	Input range:	0—4.1 V
	Input resistance:	> 1 MΩ
	A/D converter:	12-bit
	A/D converter inaccuracy:	± 1 LSB
	Module inaccuracy:	< 0.25%
	Absolute max. input signal:	± 36 Vdc
	Cross talk between channels:	> 60 dB[3]
	External voltage read back:	
	• range	0—4.1 V
	• input resistance	typically 1 MΩ
Key coding	(See section “Key coding” on page 17)	
	Module connector code:	
	• holes	A5, C25
	Chassis connector code:	
	• large pins	A5, C25

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.
FA-type modules can be used to connect to devices in explosive atmospheres, conform to the ATEX guidelines in the *Safety Manager TUV EExn Approval Manual (PM.MAN.8183)*. ATEX approved modules have the letters “CA” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved design. There are no functional changes.

3 Cross talk is defined as follows: A step response on one channel from 0—100% v.v. shall not influence any other analog input channel beyond its two least significant bits (LSBs), i.e. 20 ∗ log (4 / 4096).

SDIL-1608

Safe loop-monitored digital input module with earth fault monitor (16 channels)

Description

The SDIL-1608 digital input module has sixteen channels for either loop-monitored loops or status signals derived from proximity switches, as set in DIN 19234 (NAMUR). The module also supports monitoring of earth faults that occur within these sixteen loops.

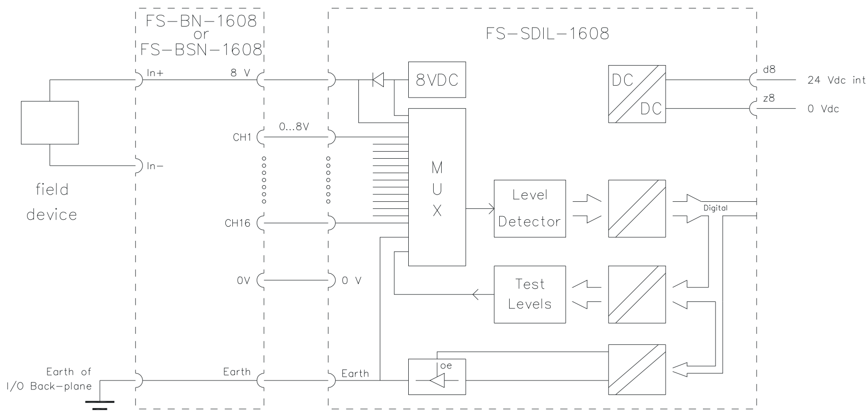
The SDIL-1608 module can be used in applications up to SIL 3, in compliance with IEC 61508.

The power for the connected field devices is supplied by an on-board DC/DC converter common to all sixteen channels.

LEDs on the front of the module indicate the status of the channel, loop and module diagnostics.

The input of proximity switch signals to the SDIL-1608 module needs to be converted to a level that is suitable for the SDIL-1608 module. To enable this conversion, you need to place the signal converter module BN-1608 or BSN-1608 on programming connector P_x on the back of the IO backplane in the IO chassis.

Figure 186 Schematic diagram for connection of inputs to SDIL-1608 module



Self-test

The self-test of the module, which is controlled by the SM Controller, includes:

- Functional tests of the various trip levels applied
- Channel independence
- Monitoring of supply voltage to input devices
- Earth connection
- Used supply voltages

Field devices

Different types of field devices can be connected to the SDIL-1608 channels, depending on the signal converter that is used, as shown in Table 50 on page 314.

Table 50 Connection of field devices

Type of field signal	Used converter type	
	BN-1608	**BSN-1608**
Dry contacts with line monitoring function[1]	Yes	Yes
Dry contacts without line monitoring function	Yes	Yes[2]
Proximity switches according to DIN 19234 (NAMUR), for example Pepperl+Fuchs (P+F) N-series	Yes	No
Pepperl+Fuchs (P+F) SN-series safe proximity switches (ferrometal sensing)[3]	No	Yes
Pepperl+Fuchs (P+F) S1N-series safe proximity switches (non-ferrometal sensing)***	No	Yes

1 This requires a line terminator with a 10 kΩ resistor and a 1 kΩ resistor ±10%, 0.25 W (see electronic diagrams in the first column of Table 52 on page 317).

2 Max. 8 channels per BSN-1608 converter may be used for dry contacts without line-monitoring function.

3 The combination of safe sensors with the safe input module SDIL-1608 meets the safety integrity requirements in IEC 61508.

Earth fault monitor

For proper operation of the earth fault monitor, you need to ensure there is an earth connection for pin z28 of the SDIL-1608 module and the monitor software has been activated.

The earth fault monitor uses floating field sensors to check for and indicate a connection between any of the 2x16 input wires and earth. In zener-barrier applications, the earth fault monitor checks for and indicates a loss of connection between the ‘8 Vdc’ of the SDIL-1608 module and earth.

LED indicators

The module front has a number of LED indicators that indicate the status of the channel, loop and module.

Each channel has two LEDs to indicate its status.

- The green channel LED shows the channel status is high **(ON)** or low (**OFF**).
- The **red** channel LED shows a fault occurred in the channel, or if a lead breakage or short circuit was found (**ON**).

For inputs without active line monitors, these two LEDs are always off.

Table 51 on page 316 and Table 52 on page 317 shows the status indications of the green and red channel LEDs for different field situations.

The bi-colored earth LED indicates whether the earth connection test is OK (**green**), false (**red**) or disabled (**OFF**).

The bi-colored status LED indicates whether the module is OK (**green**) or faulty/not running (**red**).

Figure 187 Module front

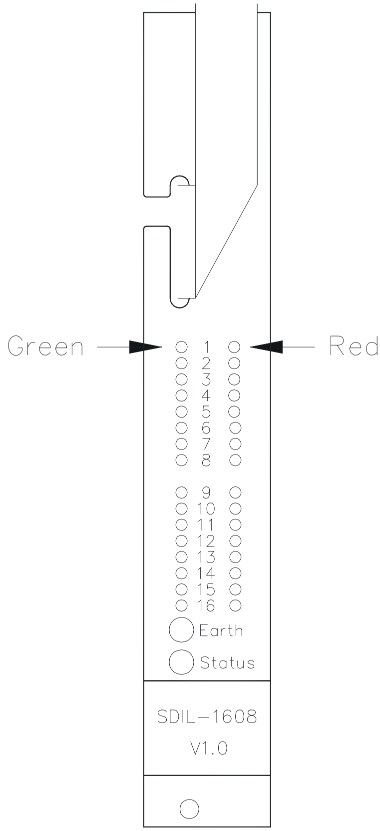


Table 51 Status LED behavior for line-monitored inputs

Field status	Green channel LED	Red channel LED
Normal	See Table 52 on page 317	ON/OFF[1]
Lead breakage	OFF	ON
Short circuit	ON	ON

1 OFF if no channel fault has been detected since the last fault reset.
ON if a channel fault has been detected since the last fault reset.

Table 52 Green channel LED behavior

	field situation	green channel LED	loop monitored
IN+ IN− DIN 19234 NAMUR	sensor I < 1.2mA	OFF	YES
IN+ IN− DIN 19234 NAMUR	sensor I > 2.1mA	ON	
IN+ IN− P+F SN sensor	sensor covered (safe state)	OFF	YES
IN+ IN− P+F SN sensor	sensor uncovered (active state)	ON	
IN+ IN− P+F S1N sensor	sensor uncovered (safe state)	OFF	YES
IN+ IN− P+F S1N sensor	sensor covered (active state)	ON	
IN+ 1K 10K IN−	switch open	OFF	YES
IN+ 1K 10K IN−	switch closed	ON	
IN+ 1K 10K IN−	switch open	OFF	YES
IN+ 1K 10K IN−	switch closed	ON	
IN+ IN−	switch open	OFF	NO
IN+ IN−	switch closed	ON	
IN+ IN− Spare	any	OFF	NO

Hazardous locations (FM 3611)

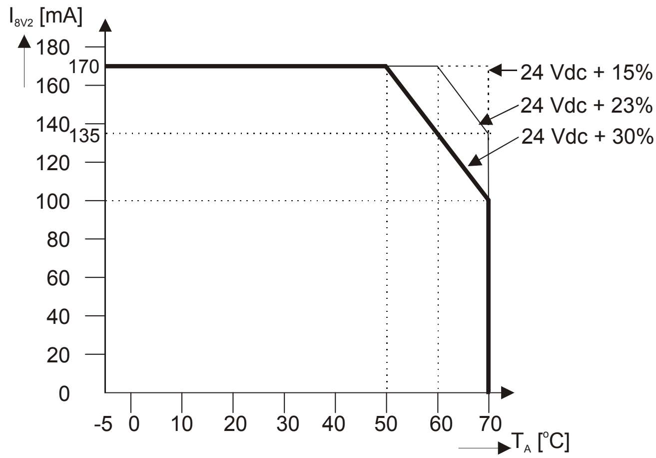
The SDIL-1608 module can be used for hazardous zones in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG).
Its non-incentive field device may reside in Division 2 area but module, FTA and converter must reside in a non-hazardous area. For more details, see the FM Approval Guide EP-SM.6287.

Maximum output load

The power for the connected field devices is supplied by an on-board DC/DC converter, common to all sixteen channels.

Figure 188 on page 318 shows the derating curve of the total 8V output load versus the ambient temperature and (24 Vdc) supply voltage level.

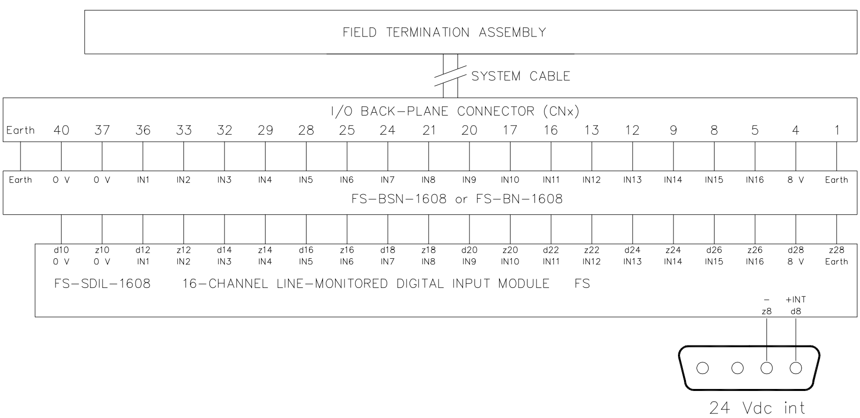
Figure 188 Derating curve (8V output load current vs. ambient temperature) for the SDIL-1608



Connection example

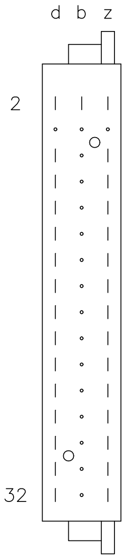
Figure 189 on page 318 shows a typical connection example for SDIL-1608.

Figure 189 Connection example of SDIL-1608 module with signal converter BN-1608



Pin allocation

The following overview contains the back view and pin allocation of the SDIL-1608 module connector:



d2		b2	GND	z2	5 Vdc
d4	-			z4	-
d6				z6	
d8	Int. 24 Vdc supply			z8	Int. 0 Vdc supply
d10	0 Vdc Out			z10	0 Vdc Out
d12	IN 1			z12	IN 2
d14	IN 3			z14	IN 4
d16	IN 5			z16	IN 6
d18	IN 7			z18	IN 8
d20	IN 9			z20	IN 10
d22	IN 11			z22	IN 12
d24	IN 13			z24	IN 14
d26	IN 15			z26	IN 16
d28	8 Vdc Out			z28	Earth
d30				z30	
d32				z32	

Technical data

The SDIL-1608 module has the following specifications:

General	Type numbers[1 2]:	FS-SDIL-1608 V1.1
		FC-SDIL-1608 CC V1.1
		FA-SDIL-1608 CA V1.1
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 160 mA 24 Vdc, 110 mA
Input	The following specifications are all in combination with BN-1608.	
	Number of input channels:	16
	Input type:	according to DIN 19234 (= NAMUR)
	Switch level:	1.4—1.9 mA
	Hysteresis:	0.2 mA ± 0.05 mA
	Input filter:	first order, low pass 100 Hz
	Field wire resistance:	max. 50 Ω
	8 V loop supply:	
	• output voltage	7.9—8.7 V
	• output current	170 mA (short-circuit proof)[3]
Earth	Connection monitor:	1
	Input resistance:	typically 0.5 MΩ (–40V < U < 40V)
	Test current:	typically 0.5 mA
	Output voltage:	typically 0.5 Vdc
	Field fault voltage:	max. 250 Vac
Key coding	(See section “Key coding” on page 17)	
	Module connector code:	
	• holes	A5, C29
	Chassis connector code:	
	• large pins	A5, C29

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.
FA-type modules can be used to connect to devices in explosive atmospheres, conform to the ATEX guidelines in the *Safety Manager TUV EExn Approval Manual (PM.MAN.8183)*. ATEX approved modules have the letters “CA” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 have an improved designed. There are no functional changes.

3 This current is the maximum output current. To determine the actual output current limitation see “Maximum output load” on page 318.

Input converter modules

9

This chapter describes the input converter modules that are available for Safety Manager.

The following input converter modules are described:

Input converter module		See
BSAI-04x + BSDIL-0426	Analog input converter modules for use with SAI-0410	page 324
BSAI-1620mE	Analog input converter module, 0—25 mA to 0—4.1 V (16 channels)	page 335
BSDI-16UNI	Converter module for normally open digital inputs with ELD function (16 channels)	page 337
BN-1608	Digital converter module for NAMUR Signals (16 channels)	page 339
BSN-1608	Digital converter module for Safety sensor signals (16 channels)	page 341

For related input modules, see “Input modules” on page 289.

General info about input converter modules

An input converter module converts input field signals to values appropriate for the Safety Manager input module being used. Converting input field signals can also be done on the FTA (see “General info about Termination Assembly modules” on page 501).

The converter modules described here are “B” type converters, meaning they are placed on an IO programming connector on the IO backplane in the IO chassis.

Table 53 on page 322 shows all available input converter modules and the input modules for which they are used.

Table 53 input converter modules and their corresponding input modules

Input converter module	Input module
BSAI-0420mI BSAI-0420mE BSAI-0405E BSAI-0410E BSDIL-0426	SAI-0410
BSAI-1620mE	SAI-1620m
BSDI-16UNI	SDI-1624 SDI-1648
BN-1608	SDIL-1608
BSN-1608	SDIL-1608

Figure 190 on page 323 shows a part of the back of a non-redundant IO chassis with input converters in slots P1, P4, P6 and P7.

Figure 190 Detail of the back of a non-redundant IO chassis

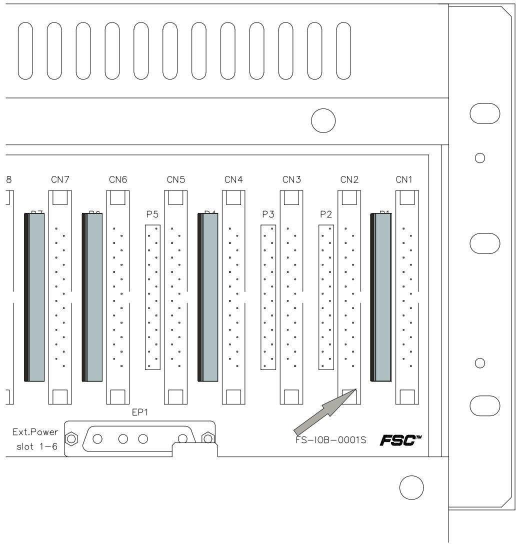
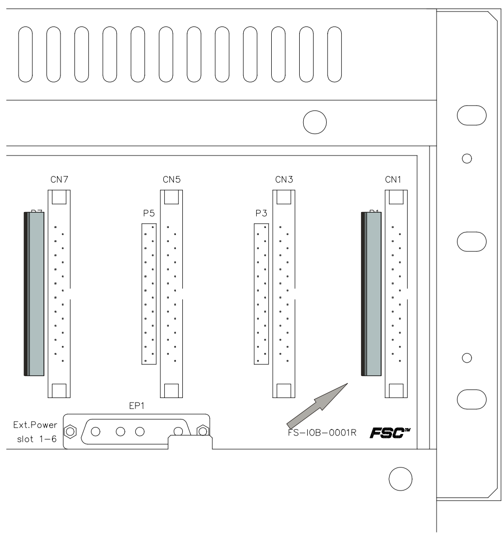


Figure 191 on page 323 shows a part of the back of a redundant IO chassis with input converters in slots P1 and P7.

Figure 191 Detail of the back of a redundant IO chassis



BSAI-04x + BSDIL-0426

Analog input converter modules for use with SAI-0410

Description

The analog inputs of an SAI-0410 module require an BSAI-04x or BSDIL-0426 analog input converter module to convert field signals into 0—2 V signals for the SAI-0410 module.

The following analog input converters are available for the SAI-0410:

- “BSAI-0420mI” on page 325
- “BSAI-0420mE” on page 327
- “BSAI-0405E” on page 329
- “BSAI-0410E” on page 331
- “BSDIL-0426” on page 333

The BSAI-04x or BSDIL-0426 module is placed on a programming connector (Px) on the back of the IO backplane in the 19-inch chassis.

Redundant modules require only one BSAI-04x or BSDIL-0426 module.

BSAI-0420mI

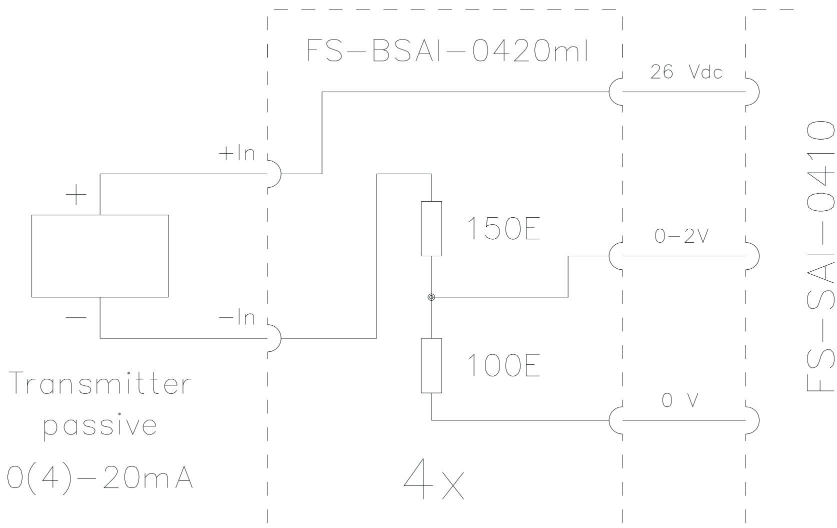
Safe analog input converter module, 0(4)—20 mA Internal power

Description

The BSAI-0420mI analog input converter converts four 0(4)—20 mA field signals to 0—2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0420mI module links the 26 Vdc power to the field.

Figure 192 Schematic diagram of BSAI-0420mI module



Technical data

The BSAI-0420mI module has the following specifications:

General	Type numbers[1] :	FS-BSAI-0420mI
		FC-BSAI-0420mI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	26 Vdc (supplied by SAI-0410 module)
Input	Number of input channels:	4
	Input current:	0(4)—20 mA
	Maximum loop resistance:	800 Ω
	Input resistance:	250 Ω 0.1%
	Transmitter voltage:	21 Vdc (± 1 V at 20 mA)
	Loop current limit:	> 20 mA solid state
	Absolute max. current:	50 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSAI-0420mE

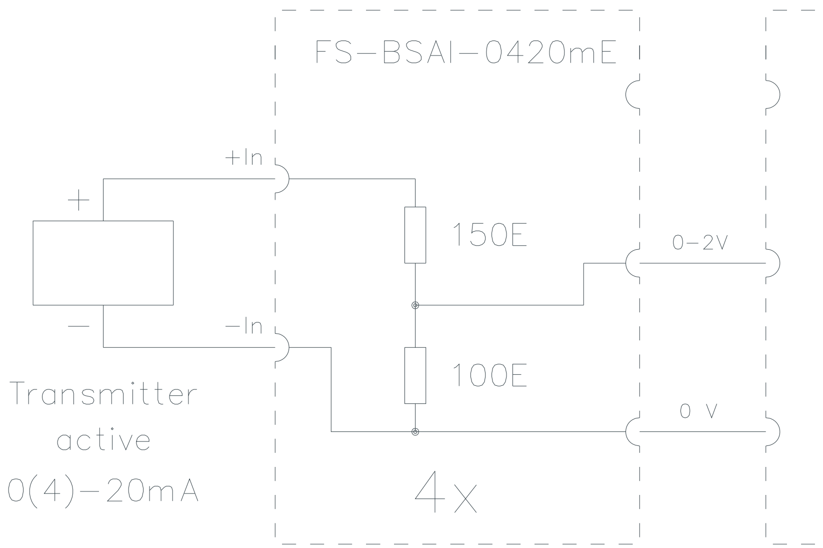
Safe analog input converter module, 0(4)—20 mA External power

Description

The BSAI-0420mE analog input converter module converts four 0(4)—20 mA field signals to 0—2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0420mE module does not supply energy to the field.

Figure 193 Schematic diagram of BSAI-0420mE module



Technical data

The BSAI-0420mE module has the following specifications:

General	Type numbers[1] :	FS-BSAI-0420mE
		FC-BSAI-0420mE
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input current:	0(4)—20 mA
	Input resistance:	250 Ω 0.1%
	Absolute max. input signal:	± 50 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSAI-0405E

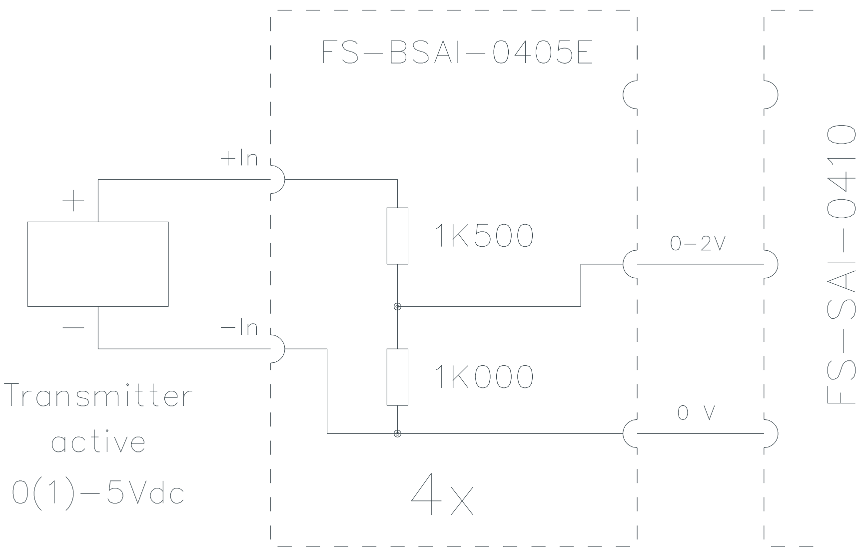
Safe analog input converter module, 0(1)—5 Vdc External power

Description

The BSAI-0405E analog input converter module converts four 0(1)—5 Vdc field signals to 0—2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0405E module does not supply energy to the field.

Figure 194 Schematic diagram of BSAI-0405E module



Technical data

The BSAI-0405E module has the following specifications:

General	Type numbers[1] :	FS-BSAI-0405E
		FC-BSAI-0405E
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input voltage:	0(1)—5 Vdc
	Input resistance:	2.5 kΩ 0.1%
	Absolute max. input signal:	± 12.5 Vdc
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSAI-0410E

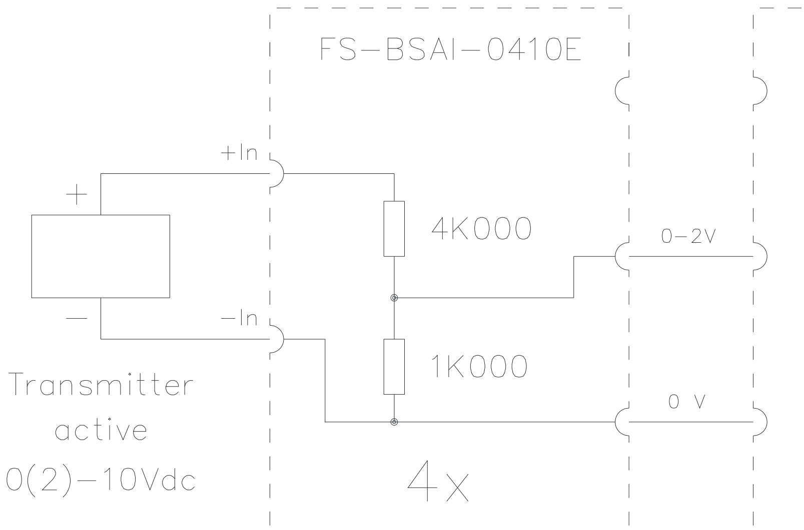
Safe analog input converter module, 0(2)—10 Vdc External power

Description

The BSAI-0410E analog input converter module converts four 0(2)—10 Vdc field signals to 0—2 V signals for a (redundant pair of) SAI-0410 module(s).

The BSAI-0410E module does not supply energy to the field.

Figure 195 Schematic diagram of BSAI-0410E module



Technical data

The BSAI-0410E module has the following specifications:

General	Type numbers[1] :	FS-BSAI-0410E
		FC-BSAI-0410E
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Input	Number of input channels:	4
	Input voltage:	0(2)—10 Vdc
	Input resistance:	5 kΩ 0.1%
	Absolute max. input signal:	± 25 Vdc
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSDIL-0426

Safe analog input converter module for loop-monitored digital signals

Description

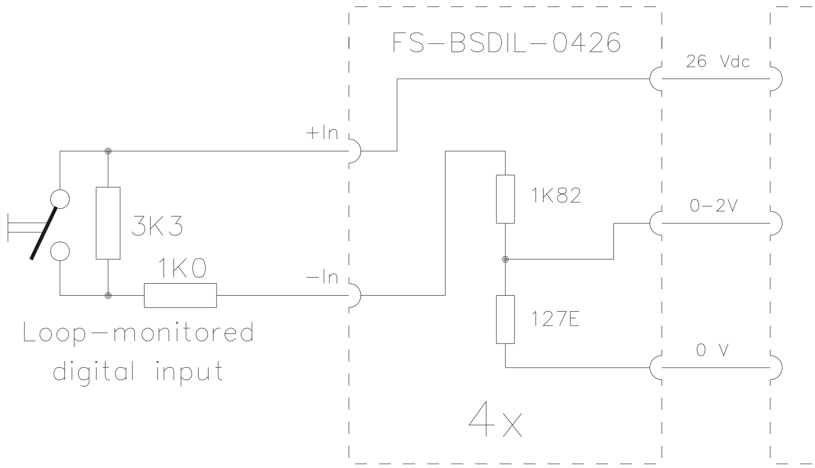
The BSDIL-0426 analog input converter module converts four field contacts with suitable resistors to 0—2 V signals for a (redundant pair of) SAI-0410 module(s).

The field resistors must be at least 0.25 W, 10%, and should be placed as close to the actual field contact as possible.

The BSDIL-0426 module supplies the 26 Vdc power to the field.

The actual ‘loop-monitored’ digital input result is obtained by assigning a functional block to this input (in the application program).

Figure 196 Schematic diagram of BSDIL-0426 module



Technical data

The BSDIL-0426 module has the following specifications:

General	Type numbers[1] :	FS-BSDIL-0426
		FC-BSDIL-0426
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	26 Vdc (supplied by SAI-0410 module)
Input	Number of input channels:	4
	Lead breakage voltage:	Approximately 26 Vdc
	Input resistance:	Approximately 2 kΩ
	Short-circuit current:	Approximately 13 mA
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSAI-1620mE

Analog input converter module, 0—25 mA to 0—4.1 V (16 channels)

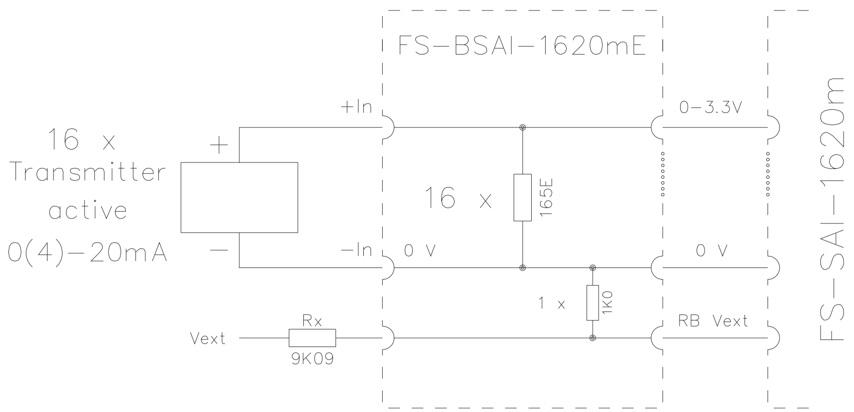
Description

The analog input converter module BSAI-1620mE converts sixteen 0(4)-20 mA field signals to 0(0.66)—3.3 V signals for the safe high-density analog input module SAI-1620m.

The BSAI-1620mE is not used if the 0-20 mA field signals to 0—3.3 V conversion is already done elsewhere (e.g. by the FTA on the rail).

All inputs are passive and have a common 0 V connection. The converter module BSAI-1620mE has been prepared for external power read-back. This only requires one extra resistor of 9.09 kΩ (1%) to rescale the voltage range (0—41 V).

Figure 197 Schematic diagram



Technical data

The BSAI-1620mE module has the following specifications:

General	Type numbers[1] :	FS-BSAI-1620mE
		FC-BSAI-1620mE
	Approvals:	CE, TUV, UL, CSA
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0(4)—20 mA (full scale = 25 mA)
	Input resistance:	165 Ω 0.1%
	Absolute max. input current:	50 mA
Read back input	R_x resistor:	9.09 kΩ 1%, 0.6 W
	Input voltage (Vext):	0—41 V
	Input resistance (Vext):	10.1 kΩ 1%
	Absolute maximum (Vext):	80 V
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

BSDI-16UNI

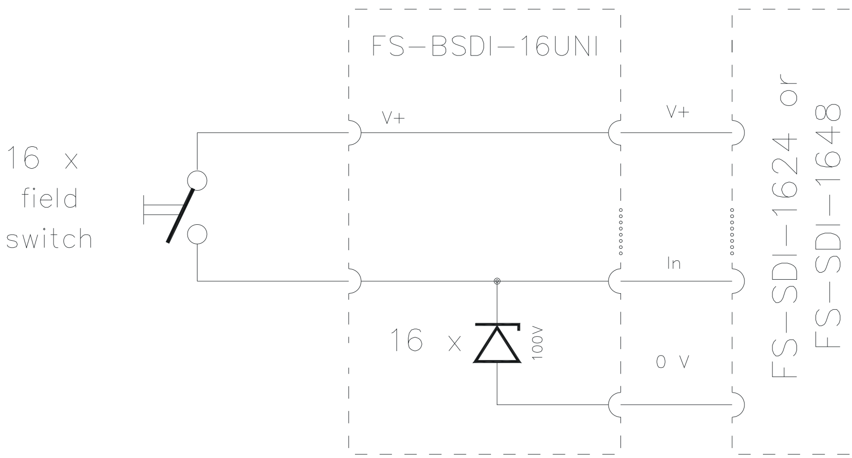
Converter module for normally open digital inputs with ELD function (16 channels)

Description

The BSDI-16UNI converter module for normally open (NO) digital inputs with an earth leakage detector (ELD) on the supply, provides sixteen transient voltage suppressor diodes for the input channels of a SDI-1624 or SDI-1648 digital input module.

The diodes enable earth fault detection by the 10310/1/1 module in case of earth faults at the input wires of an input signal with an open field contact. Earth faults at the power supply or to input wires of inputs signals with closed field contacts are already detected by the 10310/1/1 module without the use of the BSDI-16UNI module.

Figure 198 Schematic diagram



Technical data

The BSDI-16UNI module has the following specifications:

General	Type numbers[1] :	FS-BSDI-16UNI
		FC-BSDI-16UNI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Digital input	Number of input channels:	16
	Input voltage:	Max. 90 V
	Reverse current:	Max. 200 mA
	Reverse voltage drop:	< 1 V
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

BN-1608

Digital converter module for NAMUR Signals (16 channels)

Description

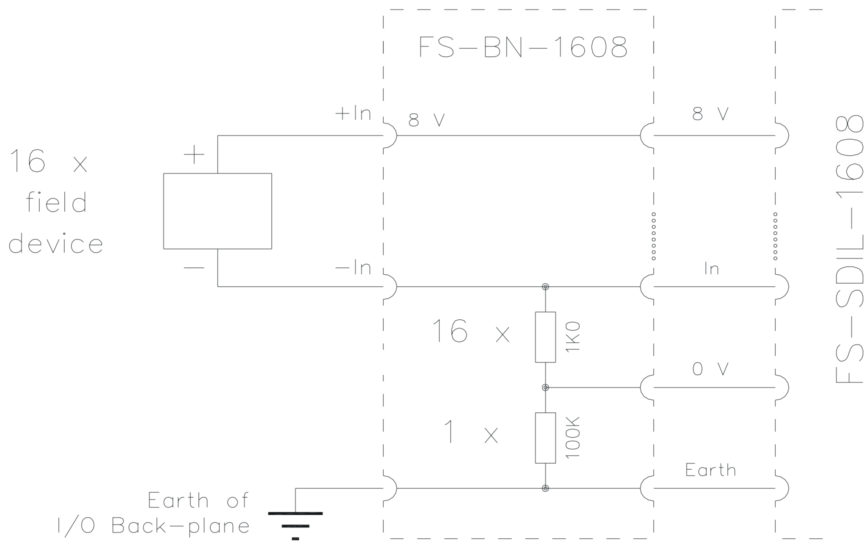
The NAMUR signal converter module BN-1608 converts sixteen NAMUR field signals to 0—8 V signals for the safe line-monitored digital input module SDIL-1608.

All inputs are passive and have a common 8 V connection.

The BN-1608 module connects the earth pin of the SDIL-1608 module with the earth of the IO backplane.

- If earth fault monitoring is used (`floating` selected in Safety Builder **Module properties -Advanced**) the (single) 100kΩ resistor between 0V and earth increases the maximum allowed cable length of the module.
- If earth connection monitoring is used (`grounded` is selected in Safety Builder **Module properties -Advanced**) there is no cable length limit.
- If earth monitoring is disabled (`not monitored` selected in Safety Builder **Module properties -Advanced**) there is no cable length limit.

Figure 199 Schematic diagram



Technical data

The BN-1608 module has the following specifications:

General	Type numbers[1 2]:	FS-BN-1608 V1.1
		FC-BN-1608 V1.1
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0—8 mA
	Input resistance:	1 kΩ 1%
	Absolute max. input current:	20 mA
Cable capacitance	(total of all connected cables)	< 16 µF 2
Earth resistor	Resistance:	100 kΩ 1% 2
	Maximum dissipation:	0.6 W
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules without suffix code have no 100kΩ resistor to earth and are limited to a maximum cable capacity to earth of 1.5 µF *per SDIL-1608 module* when `floating` is selected as operation mode in Safety Builder.

BSN-1608

Digital converter module for Safety sensor signals (16 channels)

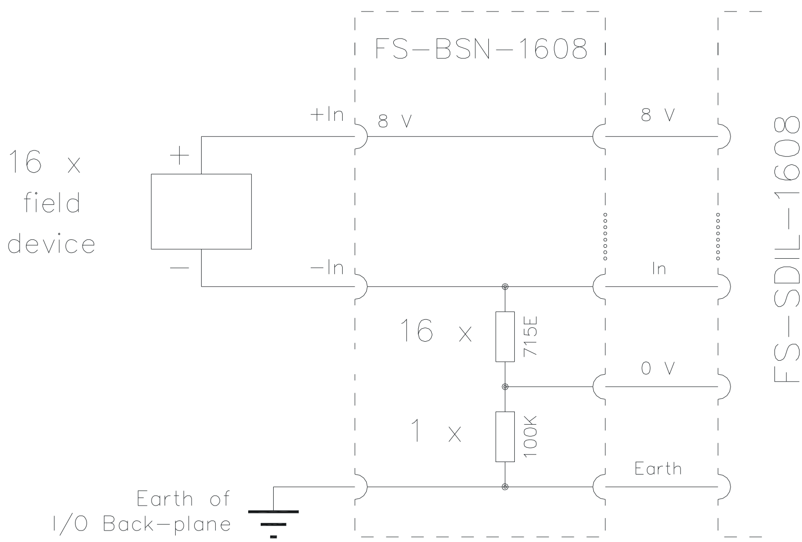
Description

The Safety sensor signal converter module BSN-1608 converts sixteen Pepperl+Fuchs (P+F) Safety sensor signals to 0—8 V signals for the safe line-monitored digital input module SDIL-1608. All inputs are passive and have a common 8 V connection.

The BSN-1608 module connects the earth pin of the SDIL-1608 module to the earth of the IO backplane.

- If earth fault monitoring is used (`floating` selected in Safety Builder **Module properties -Advanced**) the (single) 100kΩ resistor between 0V and earth increases the maximum allowed cable length of the module.
- If earth connection monitoring is used (`grounded` is selected in Safety Builder **Module properties -Advanced**) there is no cable length limit.
- If earth monitoring is disabled (`not monitored` selected in Safety Builder **Module properties -Advanced**) there is no cable length limit.

Figure 200 Schematic diagram



Technical data

The BSN-1608 module has the following specifications:

General	Type numbers[1 2]:	FS-BSN-1608 V1.1
		FC-BSN-1608 V1.1
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	None
Analog input	Number of input channels:	16
	Input current:	0—11 mA
	Input resistance:	715 Ω 1%
	Absolute max. input current:	25 mA
Cable capacitance	(total of all connected cables)	< 16 µF 2
Earth resistor	Resistance:	100 kΩ 1% 2
	Maximum dissipation:	0.6 W
Physical	Dimensions:	58.5 × 28.5 × 9mm (2.3 × 1.125 × 0.35 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules without suffix code have no 100kΩ resistor to earth and are limited to a maximum cable capacity to earth of 1.5 µF *per SDIL-1608 module* when `floating` is selected as operation mode in Safety Builder.

Output modules

10

This chapter describes the output modules that are available for Safety Manager.

The following output modules are described:

output module		see
SDO-0824	Safe digital output module (24 Vdc, 0.55 A, 8 channels)	page 350
SAO-0220m	Safe analog output module (0(4)—20 mA, 2 channels)	page 356
DO-1224	Non-safe digital output module (24 Vdc, 0.55 A, 12 channels)	page 362
RO-1024	Non-safe relay output module (contacts, 10 channels)	page 366
DO-1624	Non-safe digital output module (24 Vdc, 0.1 A, 16 channels)	page 371
SDO-04110	Safe digital output module (110 Vdc, 0.32 A, 4 channels)	page 376
SDO-0448	Safe digital output module (48 Vdc, 0.75 A, 4 channels)	page 382
SDO-0424	Safe digital output module (24 Vdc, 2 A, 4 channels)	page 388
SDOL-0424	Safe loop-monitored digital output module (24 Vdc, 1 A, 4 channels)	page 394
SDOL-0448	Safe loop-monitored digital output module (48 Vdc, 500mA, 4 channels)	page 400

For related output converter modules, see “Output converter modules” on page 407.

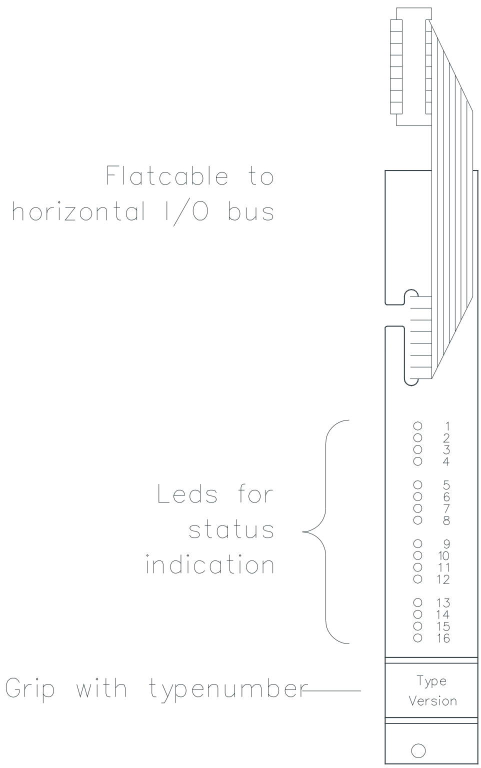
For related FTAs, see “Field Termination Assembly modules” on page 499.

General information about output modules

All output modules are European standard size (100 × 160 mm) instrument modules. The width of the module front is 4 TE = 4 HP (20.32 mm, 0.8 in), which is one slot in a standard 19-inch IO chassis.

Each output module is connected to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) via a flat cable, which extends from the module front. Digital output modules have status LEDs for each channel. The LEDs are placed in the module front, below the flatcable.

Figure 201 Front of a digital output module



There are digital output modules for 24 Vdc, 48 Vdc and 110 Vdc signals. The modules are powered with 5 Vdc for circuits associated with the horizontal bus logic, and with 24 Vdc, 48 Vdc or 110 Vdc for the circuits associated with the output signals.

There is an analog output module for 0—20 mA field signals.

The output modules are fitted with a male connector according to DIN 41612, type F, with the d, (b) and z rows used.

The following items are terminated on the chassis connector:

- The internal power supply of 5 Vdc,
- The internal control input for the secondary means of de-energization (WD input),
- The internal and external power supply of 24 Vdc or other supply voltages (48 Vdc or 110 Vdc), and
- The wiring for the output signals.

All output modules have galvanic isolation between the 5 Vdc circuitry and the output circuitry for separation between the processor and field section.

If indicated, the output modules are ‘fail-to-safe’. This means that in case of a component failure of the output module the outputs can still be switched off. The safe property of output modules is mainly achieved through self-test routines and additional (test) circuits on the module.

The fail-to-safe output modules have a secondary means of de-energization via the watchdog (WD) inputs (5 Vdc level). This makes it possible to de-energize an output irrespective of the horizontal IO bus (IOBUS-HBS or IOBUS-HBR) control signals. This results in a de-energized output signal to the process, which is the safe condition in a normally energized system. The safety-relevant circuitry of the module is completely covered by the self-test functions of the system.

Secondary means of de-energization

All safe output modules have a secondary means of de-energization (SMOD) included to ensure ‘single fault tolerance for safety’. With this SMOD any failing output channel can be isolated from the equipment under control (EUC).

Each safe output module has one or two ‘group-SMODs’, controlling 2 or 4 channels, and rated to switch the combined load of all channels of the group.

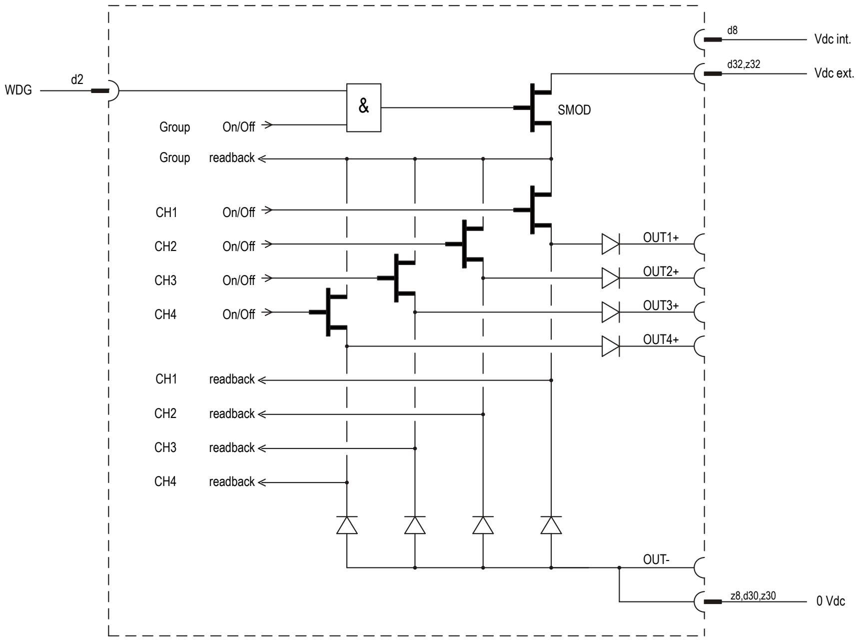
The group SMOD is tested by the processor (QPP-0001) and controlled by both the QPP and the watchdog:

- If the functional test of an output is diagnosed as faulty (fail to open), the QPP will switch off the corresponding SMOD, thereby isolating the faulty output from the EUC.
- If the functional test of the SMOD is diagnosed as faulty (fail to open), the QPP will switch off the corresponding channel outputs, thereby isolating the faulty SMOD from the EUC.

The series connection of a SMOD and the channel output, combined with full functional testing, creates ‘single fault tolerance for safety’.

Software driven full functional testing is executed by the QPP and the actual readback status is compared with the expected value. Any discrepancy found will result in safety corrective actions, meaning isolation of the fault from the EUC and notification of the operator while saving data in the diagnostics file and recording the event in the SOE.

Figure 202 Schematic diagram of a SMOD with 4 channels



The following DC supply voltage ranges apply to ensure correct operation of the Safety Manager modules:

- 110 Vdc: +25% / –15%
- 48 Vdc: +15% / –15%
- 24 Vdc: +30% / –15%

Notes:

1. If it cannot be guaranteed that the DC power supplied to Safety Manager remains within the above ranges, additional voltage monitoring is required.
2. It is assumed that the 24Vdc Plant power fed to the SM Controller is uninterrupted. If not, means should be provided to avoid power dips at the 24Vdc lines to the SM Controller.
3. When using Plant power, the Plant power supply must fulfill the requirements as laid down in IEC 61010 or IEC 60950.

Address

The address of an output module is determined by the modules slot number in the IO chassis. This means the output modules have no jumpers or switches for setting the address. Each output module can be replaced by any module of the same type.

Replacing an output module

All output modules can be replaced with the power switched on. Depending on the output signal function and the system IO configuration, process operation may be affected.

When removing an output module, first disconnect the flat cable from the horizontal IO bus (IOBUS-HBS or IOBUS-HBR), loosen the screws, then carefully pull the module from the chassis.

When placing an output module, carefully push the module into the chassis until it is flush with the chassis, fasten the screws, then connect the flat cable to the horizontal IO bus (IOBUS-HBS or IOBUS-HBR).

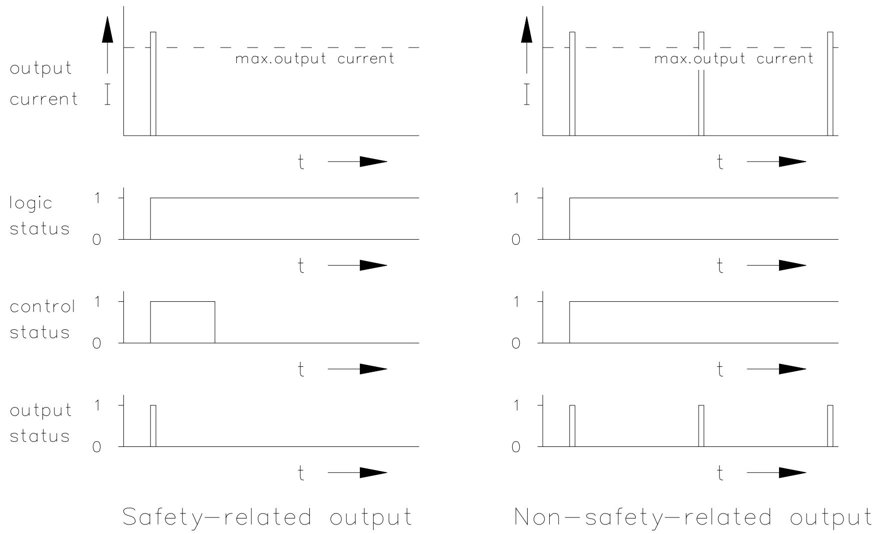
Output load, current limiting and supply voltage

The digital outputs with transistor outputs are provided with an electronic current-limiting circuit. If the output is overloaded or shorted, it goes in current limit for a brief period of time (several milliseconds), supplying *at least* the specified maximum output current. If the overload or short-circuit persists, the output switches off.

Safety-related outputs will then generate a Safety Manager system fault, and remain de-energized until a fault reset is given.

Non-safety-related outputs switch on again after a delay of several hundreds of milliseconds (see Figure 203 on page 348). A system fault is only generated if the output is a safe type.

Figure 203 Output overload / short-circuit behavior



The specified maximum output current is independent of the supply voltage. The load current usually changes in a linear fashion with the supply voltage (I = V/R). To calculate the maximum permissible load of a channel, we must take into account the maximum supply voltage we expect.

To do this, we can use the following formula:

$$I_{nl} = I_m \frac{V_n}{V_m}$$

where:

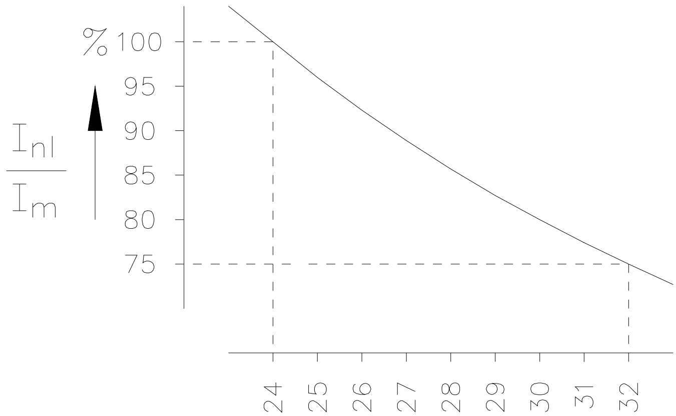
V_n = nominal supply voltage (usually 24 Vdc)

I_{nl} = nominal load current

V_m = expected maximum supply voltage

I_m = maximum output current (see module specification)

Figure 204 Maximum current derating vs. expected maximum supply voltage



Example:

We have a SDO-0824 module and we expect a maximum supply voltage of 30 V. The maximum output current of each channel is 550 mA. The current derating factor is 80% (see Figure 204 on page 349). The maximum nominal load current is then 80% ∗ 550 mA = 440 mA (≡ 10.56 W).

SDO-0824

Safe digital output module (24 Vdc, 0.55 A, 8 channels)

Description

The safe digital output module SDO-0824 has eight 24 Vdc, 550 mA output channels to drive loads up to 13 W.

These loads may be resistive (for example lamps) or inductive (for example solenoids). For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

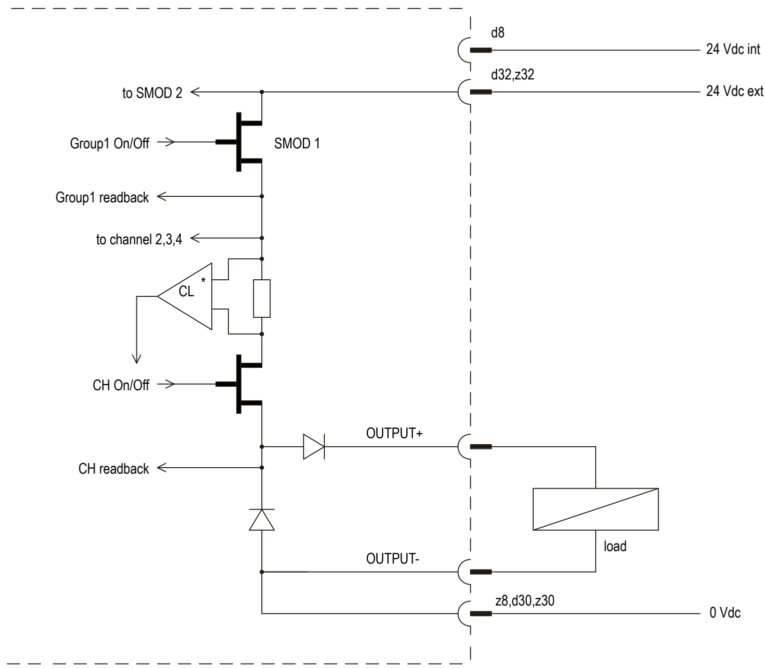
During the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize the group (via secondary means)
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs are split into two groups of four outputs each. Each group has its own secondary means of de-energizing. This increases the shutdown selectivity in case of a channel failure.

The secondary means of de-energizing (SMOD) enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application function.

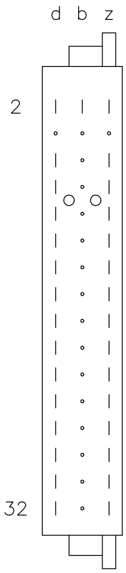
Figure 205 Schematic diagram for connection of one output to the SDO-0824 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the SDO-0824 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	-			z4	-
d6				z6	
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10	(0 Vdc)			z10	(0 Vdc)
d12	OUT 1+			z12	OUT 1-
d14	OUT 2+			z14	OUT 2-
d16	OUT 3+			z16	OUT 3-
d18	OUT 4+			z18	OUT 4-
d20	OUT 5+			z20	OUT 5-
d22	OUT 6+			z22	OUT 6-
d24	OUT 7+			z24	OUT 7-
d26	OUT 8+			z26	OUT 8-
d28	(0 Vdc)			z28	(0 Vdc)
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc ext.			z32	Supply 24 Vdc ext.

Connection examples

The next figures show a number of connection examples for the safe digital output module SDO-0824.

Attention:

The 24 Vdc internal and external power supplies must be connected to prevent fault detection during the self-test of the output module (pins d8, z8, d30/z30 and d32/z32).

Figure 206 IO connection example of SDO-0824 module for non-redundant IO configurations

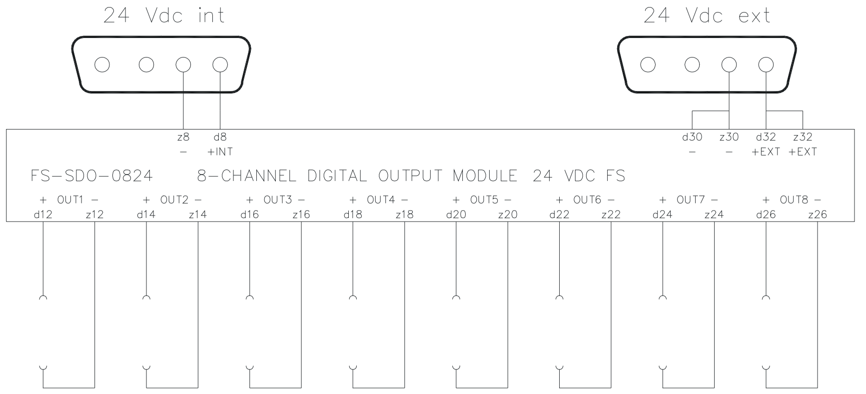


Figure 207 Connection example of SDO-0824 module to FTA for both non-redundant and redundant IO configurations

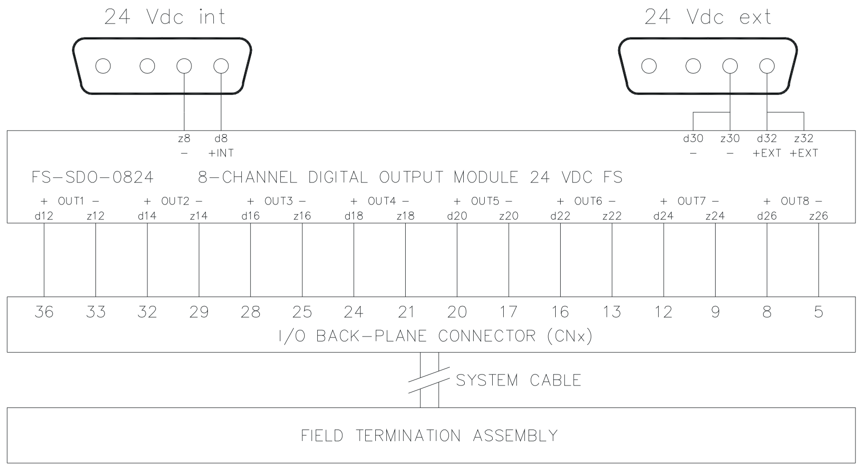
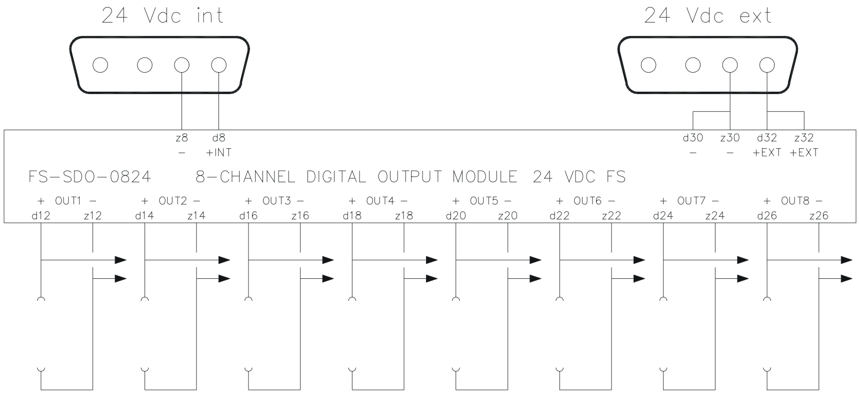


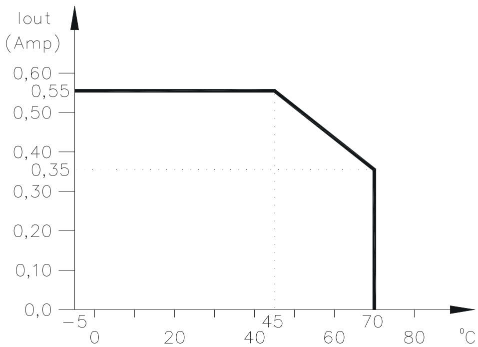
Figure 208 IO connection example of SDO-0824 module for redundant IO configurations



Maximum output load

Figure 209 on page 354 shows the maximum channel load versus the ambient temperature.

Figure 209 Derating curve (channel load vs. ambient temperature) for an SDO-0824



Technical data

The SDO-0824 module has the following specifications:

General	Type numbers[1 2]:	FS-SDO-0824 V1.2
		FC-SDO-0824 CCV1.2
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 25 mA 24 Vdc internal, 25 mA 24 Vdc external, 70 mA (without output load)
Output	Number of output channels:	8
	Output specification:	24 Vdc solid-state source, short-circuit proof
	Maximum current:	550 mA[3]
	Maximum lamp load:	120 mA (2.9 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 2.0 Vdc at 500 mA
	Off current:	< 0.1 mA
	WDG input current:	8 mA
Key coding	(See section "Key coding" on page 17)	
	Module code:	
	• holes	A9, C9
	Chassis code:	
	• large pins	A9, C9

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved design. There are no functional changes.

3 The output current is limited to 350mA at 70°C, for details see "Maximum output load" on page 354. For general information about the maximum current see section "General information about output modules" on page 344.

SAO-0220m

Safe analog output module (0(4)—20 mA, 2 channels)

Description

The safe analog output module SAO-0220m has two 0(4)—20 mA output channels for analog control applications. The load may only be resistive or capacitive. Inductive loads will cause the analog output module to be reported faulty. The two analog outputs are galvanically isolated from the 24 Vdc and the 5 Vdc. The 0 V 1 (d14) pin and 0 V 2 (d20) pin are interconnected on the module.

Each analog output channel consists of a 12-bit D/A converter for the output value and an A/D converter which reads the output value. By using the A/D converter, it is possible to check the correct functioning of the output channel.

Within the configured Diagnostic Test Interval, the analog outputs are tested for:

- Correct output value (current value ± 5%)
- Ability to de-energize
- Cross talk between analog outputs

Each analog output has a secondary means of de-energizing (SMOD). This enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application value.

Figure 210 Schematic diagram for connection of the SAO-0220m module as an active output

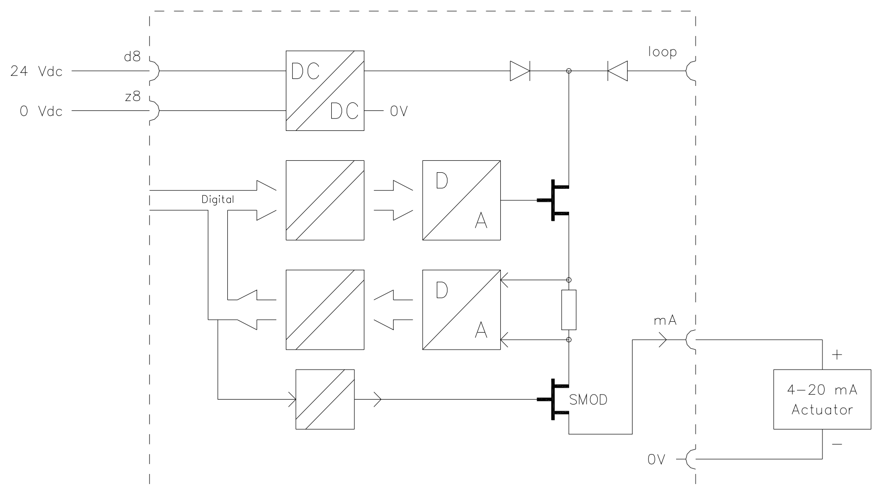
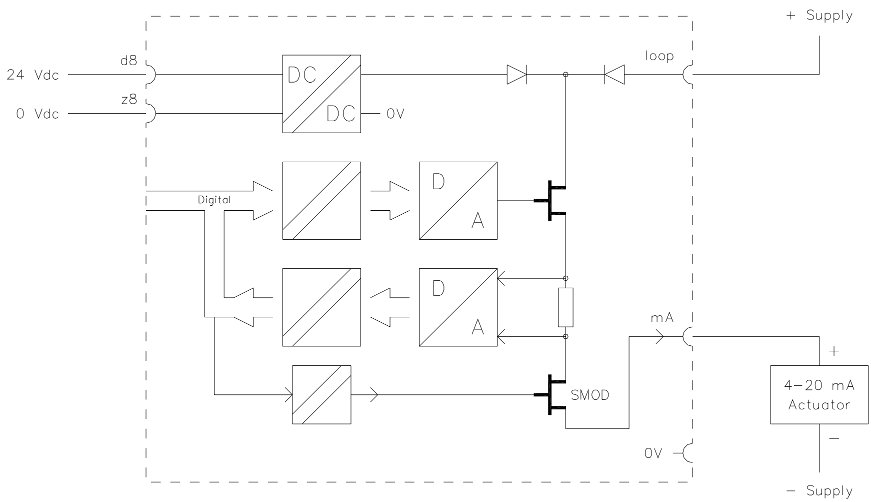


Figure 211 Schematic diagram for connection of the SAO-0220m module as a passive output



Redundant analog out

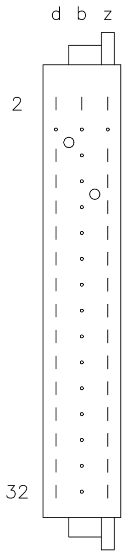
As of release 120 of Safety Builder, Safety Manager supports redundant analog outputs.

Attention:

Due to the nature of the self test procedure a fault detected on a *redundant* analog output channel may cause a dip in the output before Safety Manager switches over to the healthy channel.

Pin allocation

The back view and pin allocation of the SAO-0220m module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	–			z4	–
d6				z6	
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10				z10	
d12				z12	
d14	0 V 1			z14	
d16	mA 1			z16	Loop 1
d18				z18	
d20	0 V 2			z20	
d22	mA 2			z22	Loop 2
d24				z24	
d26				z26	
d28				z28	
d30				z30	
d32				z32	

Connection examples

The figures below show a number of connection examples for the safe analog output module SAO-0220m.

Figure 212 Connection example of SAO-0220m module to FTA for non-redundant IO configurations

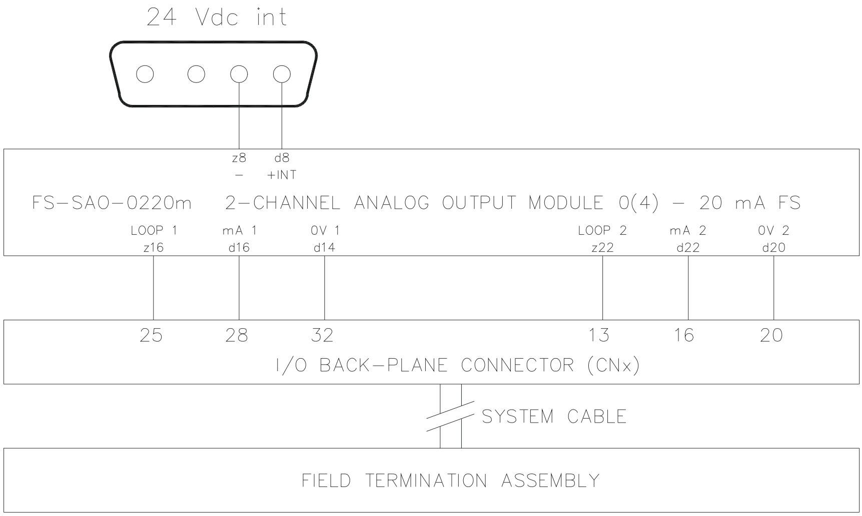


Figure 213 IO connection example for SAO-0220m module for non-redundant IO configurations (one channel active, one channel passive)

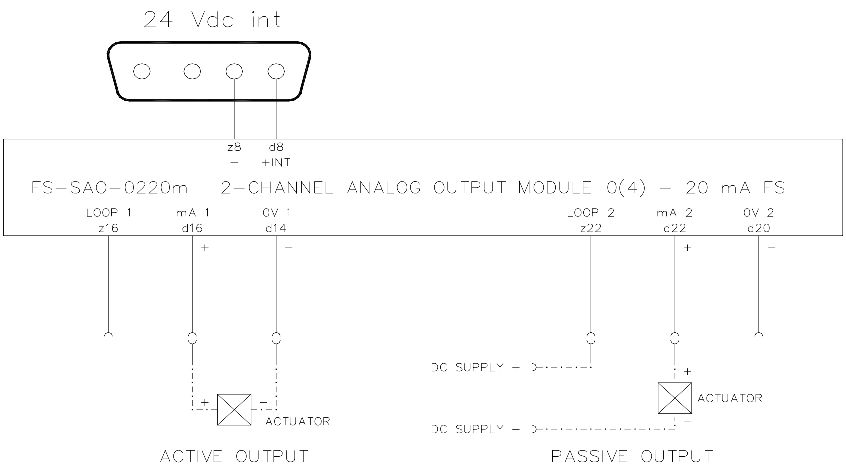
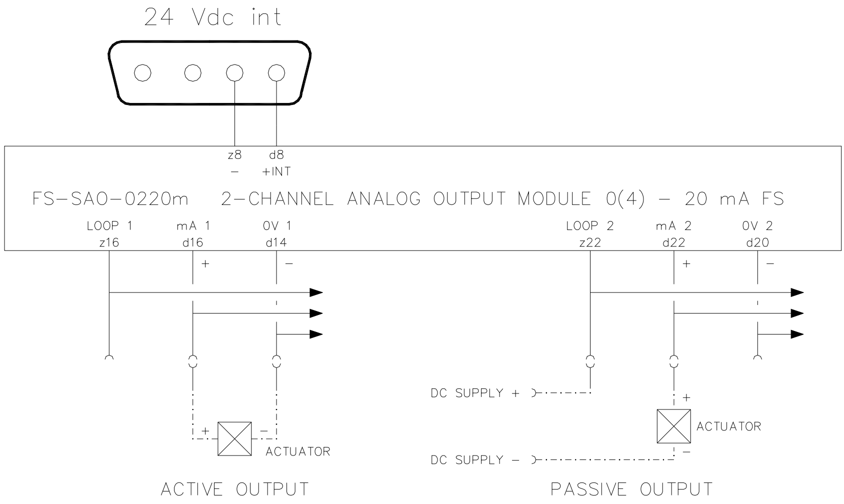


Figure 214 IO connection example for SAO-0220m module for redundant IO configurations (one channel active, one channel passive)



Note

The 24 Vdc (internal) supply must be connected to prevent fault detection during self-test.

Unused outputs must be shorted to prevent fault detection during the self-test of the module. For the FTA (TSAO-0220m), you need to link terminal 2 with 3 (for channel 1) respectively terminal 6 with 7 (for channel 2)

Hazardous locations (FM 3611)

The SAO-0220m module can also be used in non-hazardous areas for non-incendiary field circuits to Division 2 locations in compliance with FM 3611 (Class I, Division 2, Groups ABCD; Class II, Division 2, Groups FG). For more details, see the FM Approval Guide EP-SM.6287.

Technical data

The SAO-0220m module has the following specifications:

General	Type numbers[1] :	FS-SAO-0220m V1.0
		FC-SAO-0220m CCV1.0
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 30 mA 24 Vdc, 65 mA +30 mA for each active output
Output	Number of output channels:	2 (Galvanically isolated from supply voltage; 0V 1 and 0V 2 interconnected)
	Output specification (mA):	Active or passive, 0—20 / 4—20 mA
	D/A converter:	12-bit
	Off current:	< 0.05 mA
	Loop powering (active):	Maximum loop resistance: 600 Ω Maximum output voltage: 30 Vdc
	External powering (passive):	Maximum: 40 Vdc Minimum voltage drop: ≤ 7.5 V
	WDG input current:	0.5 mA
Key Coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A9, C5
	Chassis code:	
	• Large pins	A9, C5

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

DO-1224

Non-safe digital output module (24 Vdc, 0.55 A, 12 channels)

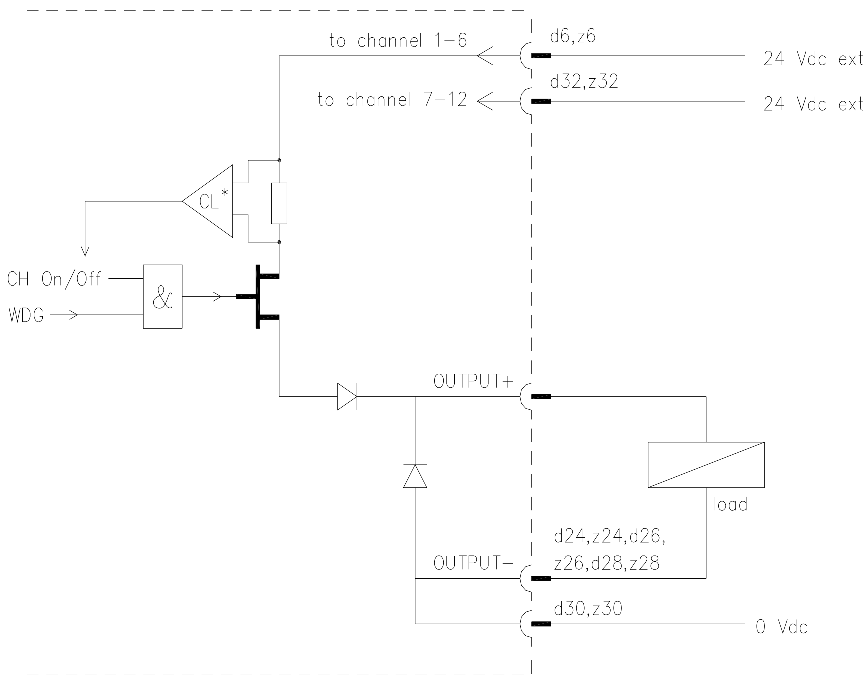
Description

The DO-1224 digital output module has twelve non-safe 24 Vdc, 550 mA output channels to drive loads up to 13 W.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode is included on each output. The outputs are not tested and can therefore *not* be used for safe applications.

The outputs are also controlled by the watchdog. This means the outputs are de-energized if the system shuts down and the watchdog switches off.

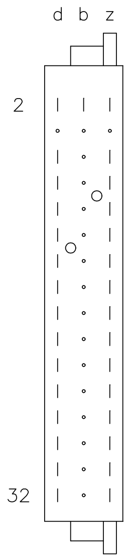
Figure 215 Schematic diagram for connection of one output to the DO-1224 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the DO-1224 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	-			z4	-
d6	Supply 24 Vdc ext.			z6	Supply 24 Vdc ext.
d8				z8	
d10				z10	
d12	OUT 1			z12	OUT 2
d14	OUT 3			z14	OUT 4
d16	OUT 5			z16	OUT 6
d18	OUT 7			z18	OUT 8
d20	OUT 9			z20	OUT 10
d22	OUT 11			z22	OUT 12
d24	0 Vdc out			z24	0 Vdc out
d26	0 Vdc out			z26	0 Vdc out
d28	0 Vdc out			z28	0 Vdc out
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc ext.			z32	Supply 24 Vdc ext.

Connection examples

The figures below show a number of examples of connections for the digital output module DO-1224.

Figure 216 IO connection example for DO-1224 module for non-redundant IO configurations

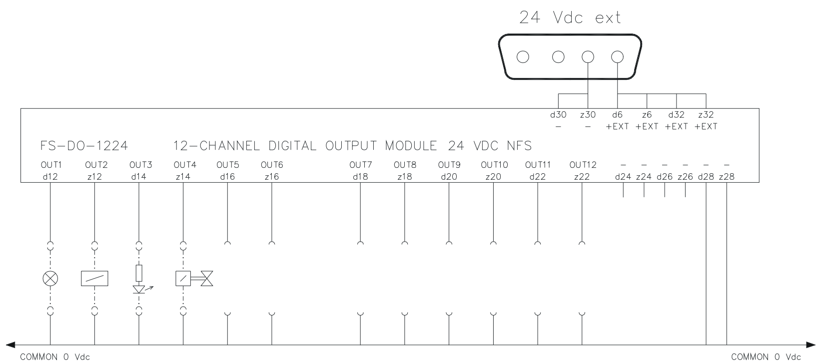


Figure 217 Connection example of DO-1224 module to FTA for both non-redundant and redundant IO configurations

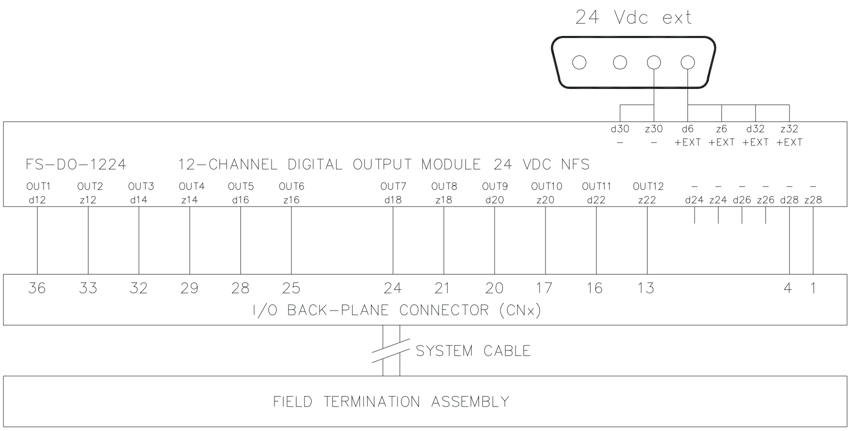
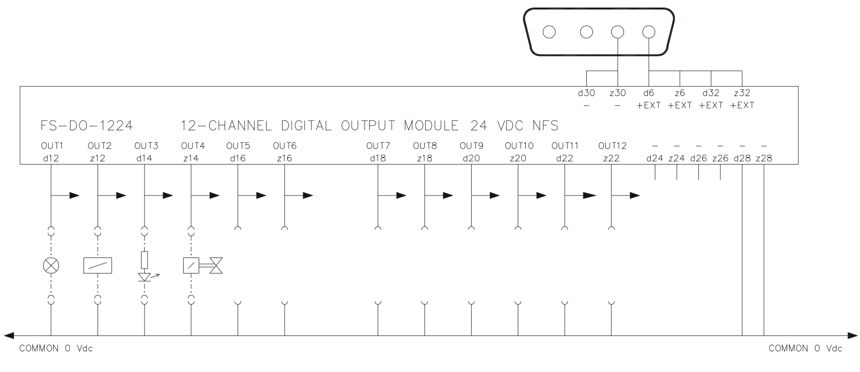


Figure 218 IO connection example for DO-1224 module for redundant IO configurations



Technical data

The DO-1224 module has the following specifications:

General	Type numbers[1] :	FS-DO-1224 V1.0
		FC-DO-1224 CCV1.0
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 25 mA 24 Vdc, 2∗30 mA (without output load)
Output	Number of output channels:	12 (2 groups of 6)
	Output specification:	24 Vdc solid-state source, short-circuit proof
	Maximum current:	550 mA[2] (see section “General information about output modules” on page 344)
	Maximum lamp load:	275 mA (6.6 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 1.5 Vdc at 500 mA
	Off current:	< 0.1 mA
	WDG input current:	0.06 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A9, C13
	Chassis code:	
	• Large pins	A9, C13

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 The maximum output current is to be derated from 100% at 60°C (140°F) to 72.7% at 70°C (158°F)

RO-1024

Non-safe relay output module (contacts, 10 channels)

Description

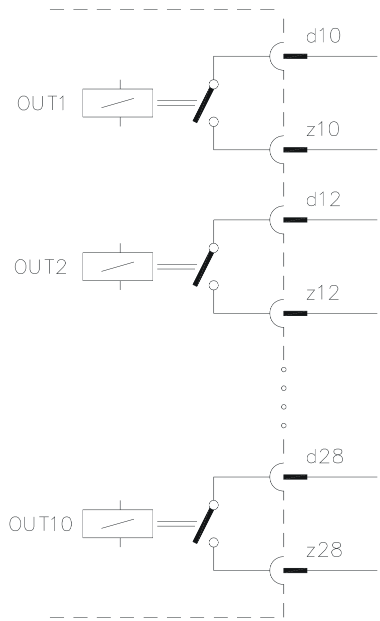
The relay output module RO-1024 has ten potential-free relay contact non-safe output channels to drive loads up to 70 W.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode **must be mounted externally.** The outputs are not tested and may therefore *not* be used for safe applications.

The maximum voltage on the relay contacts may be 36 Vdc to meet IEC 61010-1.

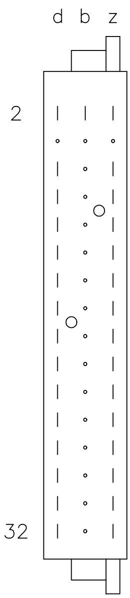
The outputs are also controlled by the watchdog. This means the relays de-energize if the system shuts down and the watchdog switches off.

Figure 219 Schematic diagram for RO-1024 module



Pin allocation

The back view and pin allocation of the RO-1024 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	-			z4	-
d6				z6	
d8	Supply 24 Vdc			z8	Supply 0 Vdc
d10	Common 1			z10	Normally open 1
d12	Common 2			z12	Normally open 2
d14	Common 3			z14	Normally open 3
d16	Common 4			z16	Normally open 4
d18	Common 5			z18	Normally open 5
d20	Common 6			z20	Normally open 6
d22	Common 7			z22	Normally open 7
d24	Common 8			z24	Normally open 8
d26	Common 9			z26	Normally open 9
d28	Common 10			z28	Normally open 10
d30				z30	
d32				z32	

Connection examples

The figures below show a number of connection examples for the relay output module RO-1024.

Figure 220 Connection example of RO-1024 module to FTA for both non-redundant and redundant IO configurations

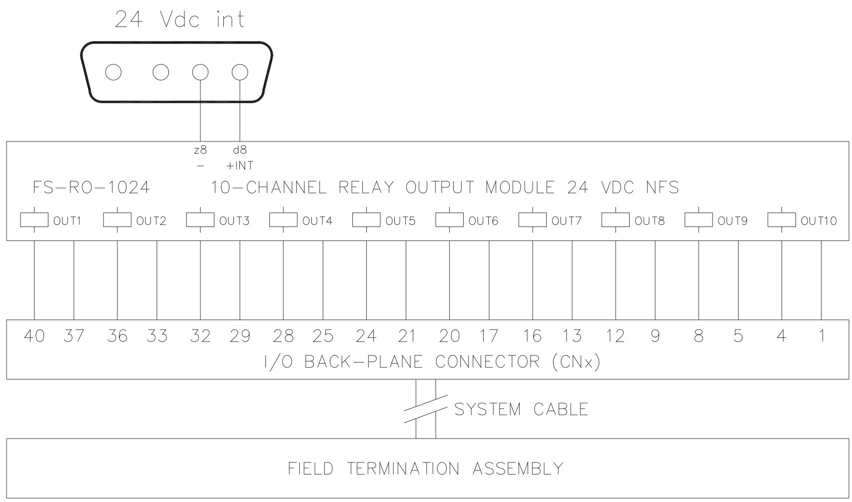


Figure 221 IO connection example for RO-1024 module for non-redundant IO configurations

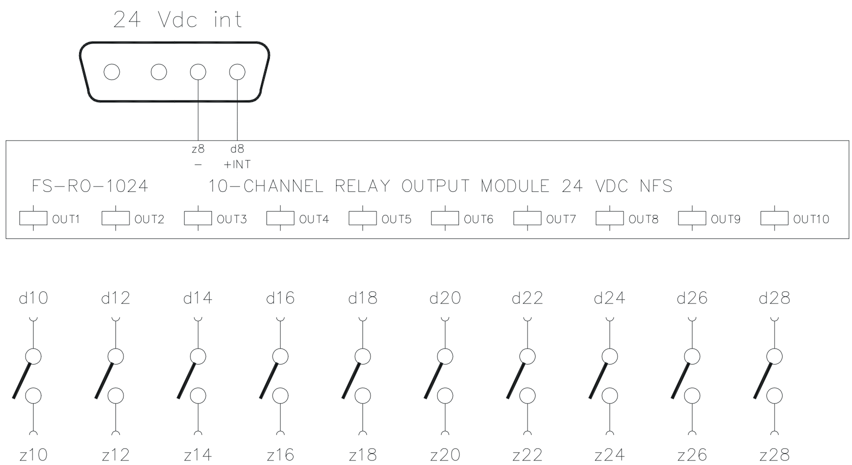
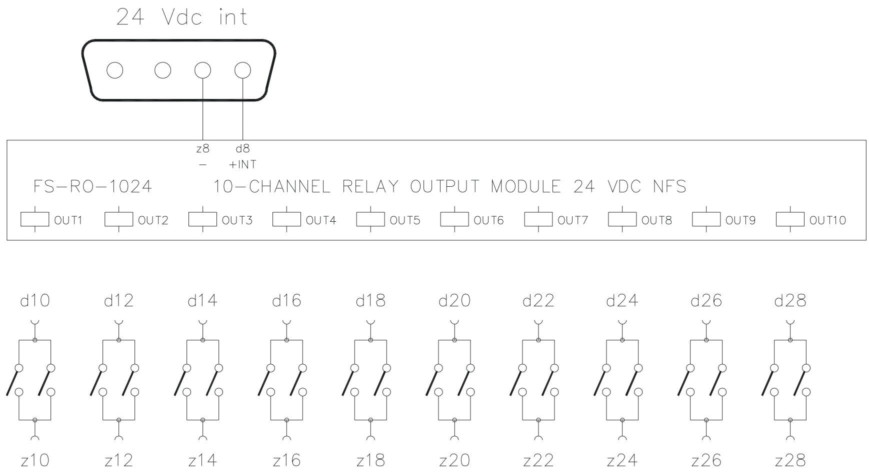


Figure 222 IO connection example for RO-1024 module for redundant IO configurations



Technical data

The RO-1024 module has the following specifications:

General	Type numbers[1] :	FS-RO-1024 V1.0
		FC-RO-1024 CCV1.0
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 25 mA 24 Vdc, 120 mA
Output	Number of output channels:	10
	Output specification:	Relay contact
	Maximum current:	2 A
	Maximum voltage:	30 Vac /36 Vdc – IEC 61010-1 (1990), over voltage category 3, Table D.12
	WDG input current	4 mA
Relay contact	Expected electrical life: • Resistive load • AC inductive load (Pf 0.4)	 1,000,000 switch operations 100,000 switch operations
	Maximum switched power:	100 W / 1000 VA
	Contact material:	Gold flash over silver alloy
Key coding	(See section "Key coding" on page 17)	
	Module code:	
	• Holes	A9, C17
	Chassis code:	
	• Large pins	A9, C17

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

DO-1624

Non-safe digital output module (24 Vdc, 0.1 A, 16 channels)

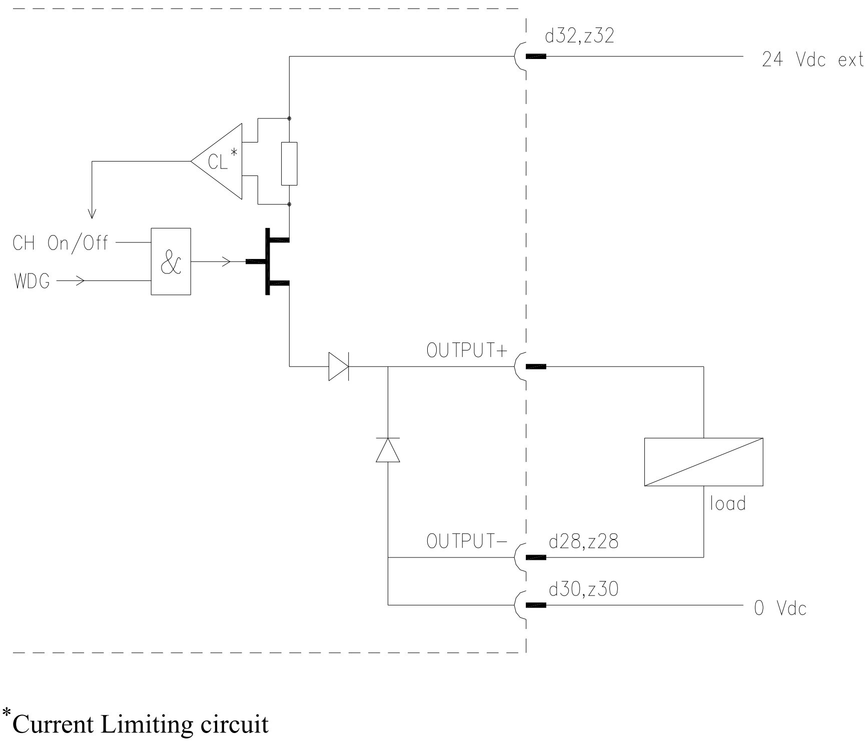
Description

The digital output module DO-1624 has sixteen 24 Vdc, 100 mA non-safe output channels to drive loads up to 2.5 W. These loads may be resistive (such as LEDs) or inductive (such as relays).

For inductive loads, a suppression diode is included on each output. The outputs are not tested and may therefore *not* be used for safe applications.

The outputs are also controlled by the watchdog. This means that the outputs are de-energized if the system shuts down and the watchdog switches off.

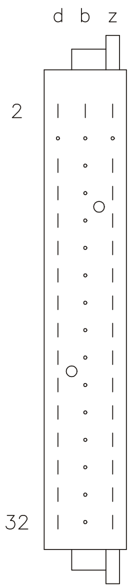
Figure 223 Schematic diagram for connection of one output to the DO-1624 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the DO-1624 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	-			z4	-
d6				z6	
d8				z8	
d10				z10	
d12	OUT 1			z12	OUT 2
d14	OUT 3			z14	OUT 4
d16	OUT 5			z16	OUT 6
d18	OUT 7			z18	OUT 8
d20	OUT 9			z20	OUT 10
d22	OUT 11			z22	OUT 12
d24	OUT 13			z24	OUT 14
d26	OUT 15			z26	OUT 16
d28	0 Vdc out			z28	0 Vdc out
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc			z32	Supply 24 Vdc

Connections examples

The figures below show a number of connection examples for the digital output module DO-1624.

Figure 224 Connection example of DO-1624 module to FTA for both non-redundant and redundant IO configurations

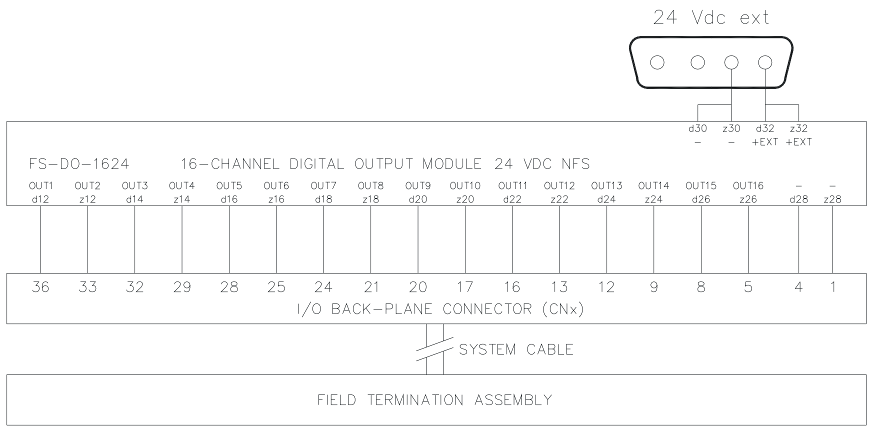


Figure 225 IO connection example for DO-1624 module for non-redundant IO configurations

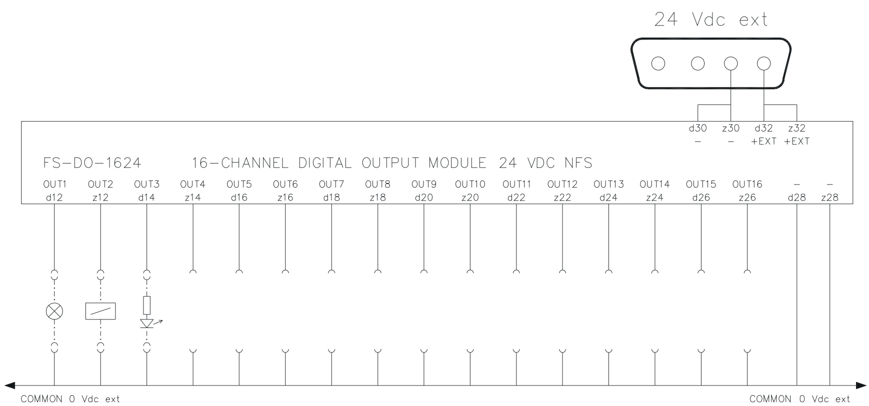
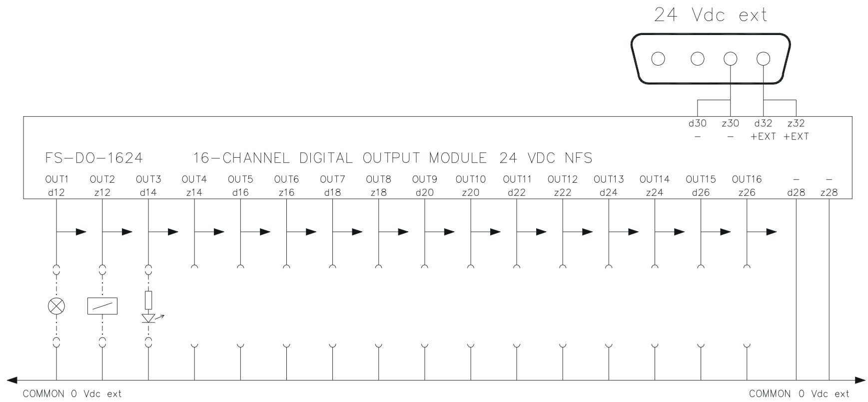


Figure 226 IO connection example for DO-1624 module for redundant IO configurations



Technical data

The DO-1624 module has the following specifications:

General	Type numbers[1] :	FS-DO-1624 V1.0
		FC-DO-1624 CCV1.0
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 35 mA 24 Vdc, 85 mA (without output load)
Output	Number of output channels:	16
	Output specification:	24 Vdc solid-state source, short-circuit proof
	Maximum current:	100 mA[2] (see section “General information about output modules” on page 344)
	Maximum lamp load:	50 mA (1.2 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 1.2 Vdc at 100 mA
	Off current:	< 0.1 mA
	WDG input current:	4 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A9, C21
	Chassis code:	
	• Large pins	A9, C21

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 The maximum output current is to be derated from 100% at 30°C (86°F) to 60% at 70°C (158°F)

SDO-04110

Safe digital output module (110 Vdc, 0.32 A, 4 channels)

Description

The safe digital output module SDO-04110 has four 110 Vdc, 325 mA output channels to drive loads up to 35 W. These loads may be resistive (for example LEDs) or inductive (for example solenoids).

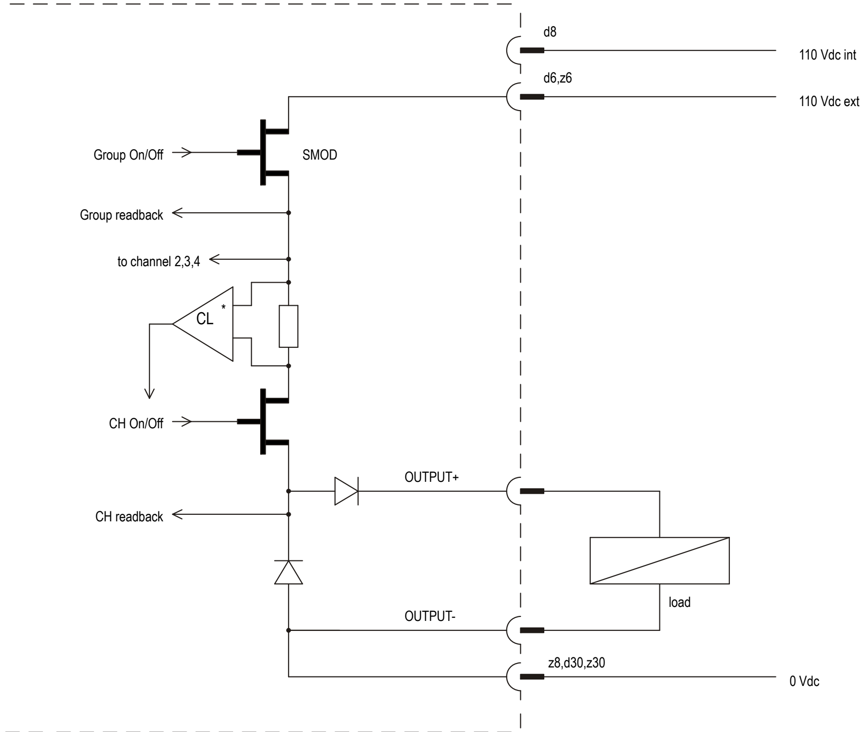
For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs have secondary means of de-energizing (SMOD). The watchdog and the processor can de-energize outputs, irrespective of the application function result.

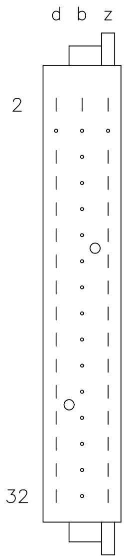
Figure 227 Schematic diagram for connection of one output to the SDO-04110 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the SDO-04110 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	–			z4	–
d6	Supply 110 Vdc ext.			z6	Supply 110 Vdc ext.
d8	Supply 110 Vdc int.			z8	Supply 0 Vdc
d10	(0 Vdc)			z10	(0 Vdc)
d12	(0 Vdc)			z12	(0 Vdc)
d14	OUT 1+			z14	OUT 1–
d16	(0 Vdc)			z16	(0 Vdc)
d18	OUT 2+			z18	OUT 2–
d20	(0 Vdc)			z20	(0 Vdc)
d22	OUT 3+			z22	OUT 3–
d24	(0 Vdc)			z24	(0 Vdc)
d26	OUT 4+			z26	OUT 4–
d28	(0 Vdc)			z28	(0 Vdc)
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32				z32	

Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-04110.

Figure 228 Connection example of SDO-04110 module to FTA for both non-redundant and redundant IO configurations

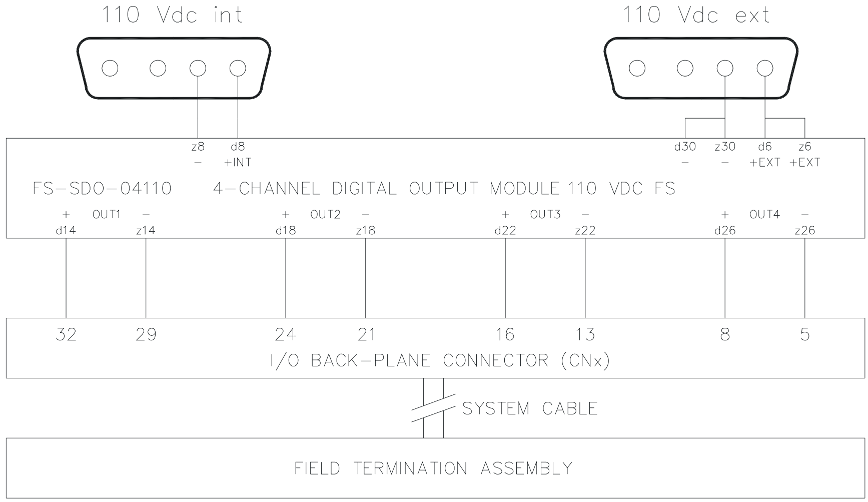


Figure 229 IO connection example for SDO-04110 module for non-redundant IO configurations

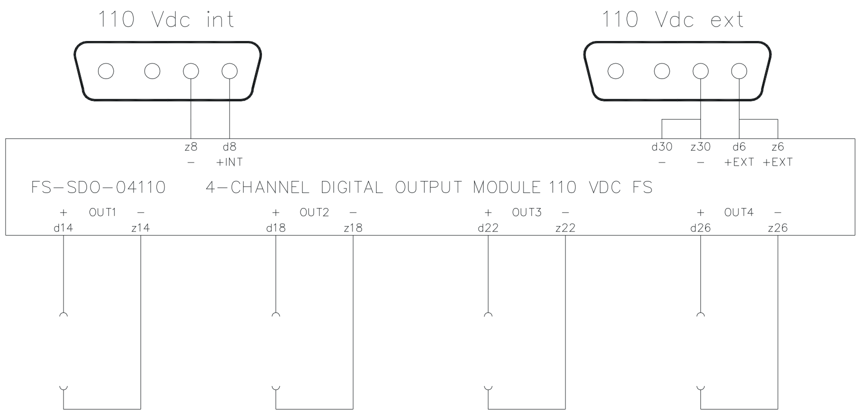
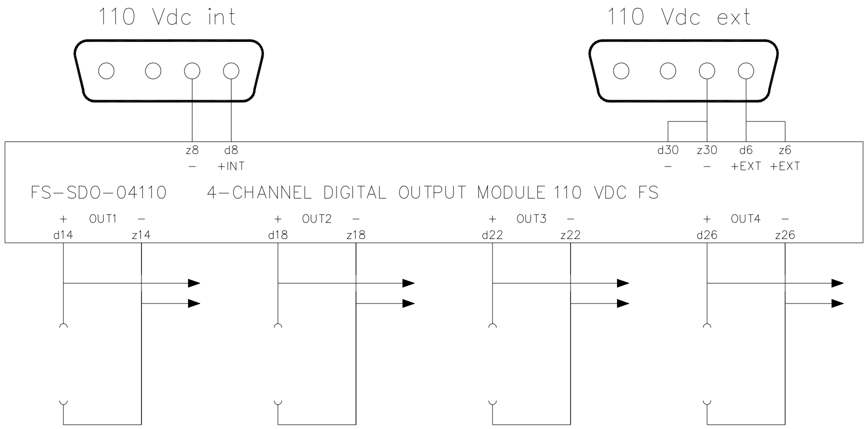


Figure 230 IO connection example for SDO-04110 module for redundant IO configurations



Note

The 110 Vdc internal and external power supplies must be connected to prevent fault detection during self-test of the output module (pins d6/z6, d8, z8, d30/z30).

Technical data

The SDO-04110 module has the following specifications:

General	Type numbers[1 2]:	FS-SDO-04110 V1.1
		FC-SDO-04110 CCV1.1
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Supply voltage:	110 Vdc, –15%—+25%
	Power requirements:	5 Vdc, 25 mA 110 Vdc internal, 10 mA 110 Vdc external, 20 mA (without output load)
Output	Number of output channels:	4
	Output specification:	110 Vdc solid-state source, short-circuit proof
	Maximum current:	325 mA[3] (see section “General information about output modules” on page 344)
	Maximum lamp load:	55 mA (6 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 2.5 Vdc at 300 mA
	Off current:	< 0.1 mA
	WDG input current:	5 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A13, C25
	Chassis code:	
	• Large pins	A13, C25

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved designed. There are no functional changes.

3 The maximum output current is to be linear derated from 100% at 60°C (140°F) to 90% at 70°C (158°F).

SDO-0448

Safe digital output module (48 Vdc, 0.75 A, 4 channels)

Description

The safe digital output module SDO-0448 has four 48 Vdc, 750 mA output channels to drive loads up to 36 W. These loads may be resistive (such as LEDs) or inductive (such as solenoids).

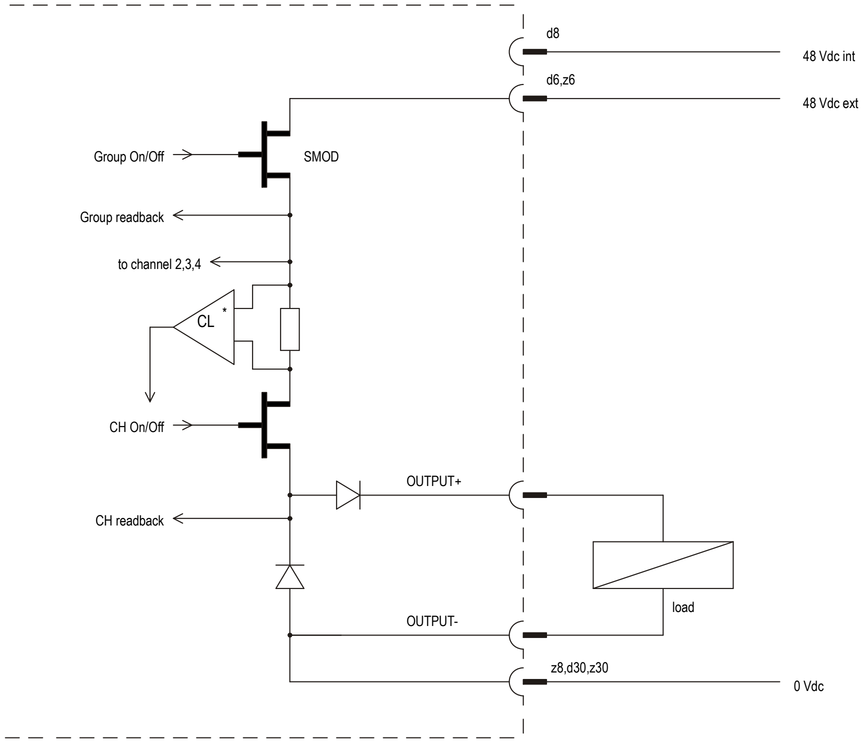
For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Crosstalk between outputs
- Functioning of the suppression diodes

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and the processor to de-energize the outputs irrespective of the result of the application function.

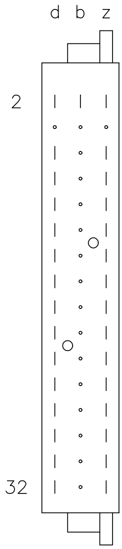
Figure 231 Schematic diagram for connection of one output to the SDO-0448 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the SDO-0448 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	-			z4	-
d6	Supply 48 Vdc ext.			z6	Supply 48 Vdc ext.
d8	Supply 48 Vdc int.			z8	Supply 0 Vdc
d10	(0 Vdc)			z10	(0 Vdc)
d12	(0 Vdc)			z12	(0 Vdc)
d14	OUT 1+			z14	OUT 1-
d16	(0 Vdc)			z16	(0 Vdc)
d18	OUT 2+			z18	OUT 2-
d20	(0 Vdc)			z20	(0 Vdc)
d22	OUT 3+			z22	OUT 3-
d24	(0 Vdc)			z24	(0 Vdc)
d26	OUT 4+			z26	OUT 4-
d28	(0 Vdc)			z28	(0 Vdc)
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32				z32	

Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-0448.

Figure 232 Connection example of SDO-0448 module to FTA for both non-redundant and redundant IO configurations

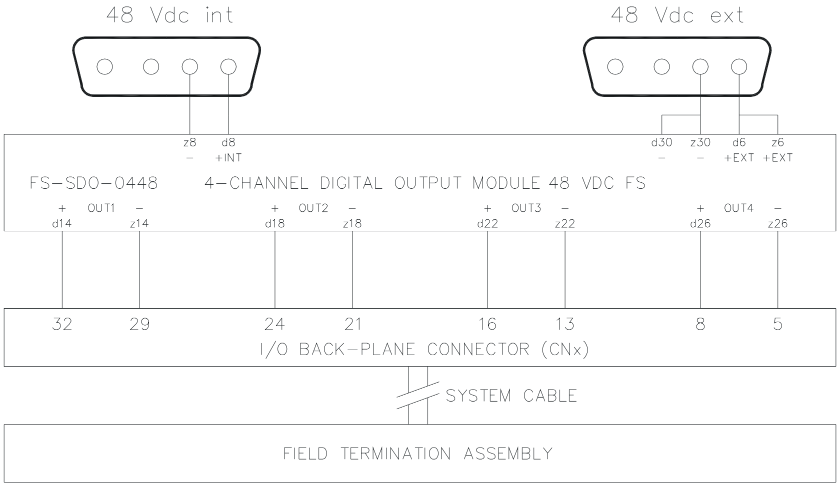


Figure 233 IO connection example for SDO-0448 module for non-redundant IO configurations

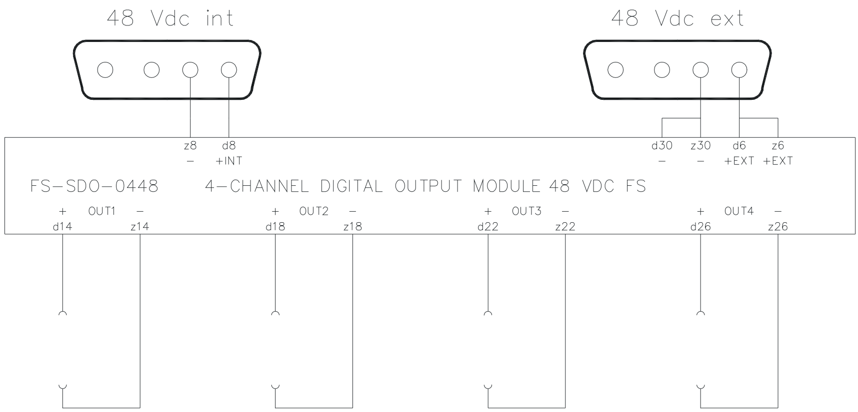
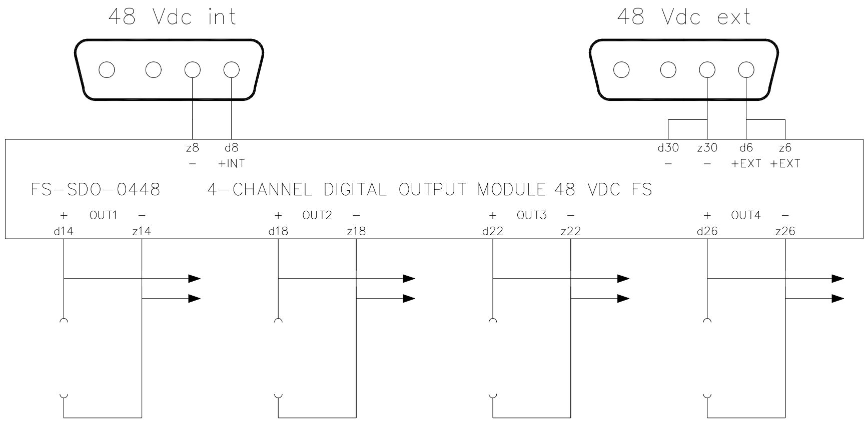


Figure 234 IO connection example for SDO-0448 module for redundant IO configurations



Note

The 48 Vdc internal and external power supplies must be connected to prevent fault detection during self-test of the output module (pins d6/z6, d8, z8, d30/z30).

Technical data

The SDO-0448 module has the following specifications:

General	Type numbers[1 2]:	FS-SDO-0448 V1.1
		FC-SDO-0448 CCV1.1
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Supply voltage:	48 Vdc ± 15%
	Power requirements:	5 Vdc, 25 mA 48 Vdc internal, 20 mA 48 Vdc external, 20 mA (without output load)
Output	Number of output channels:	4
	Output specification:	48 Vdc solid-state source, short-circuit proof
	Maximum current:	750 mA[3] (see section “General information about output modules” on page 344)
	Maximum lamp load:	125 mA (6 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 2.1 Vdc at 750 mA
	Off current:	< 0.1 mA
	WDG input current:	5 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A13, C21
	Chassis code:	
	• Large pins	A13, C21

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved designed. There are no functional changes besides the operational limits stated herein.

3 The maximum output current is to be linear derated from 100% at 60°C (122°F) to 80% at 70°C (158°F). *Output modules with suffix code V1.0* cannot be used above 60°C (122°F).

SDO-0424

Safe digital output module (24 Vdc, 2 A, 4 channels)

Description

The safe digital output module SDO-0424 has four 24 Vdc, 2 A output channels to drive loads up to 50 W. The maximum module load is 6 A.

These loads may be resistive (such as lamps) or inductive (such as solenoids). For inductive loads, a suppression diode is included on each output. The outputs, including the suppression diodes, are fully tested and may therefore be used for safe applications.

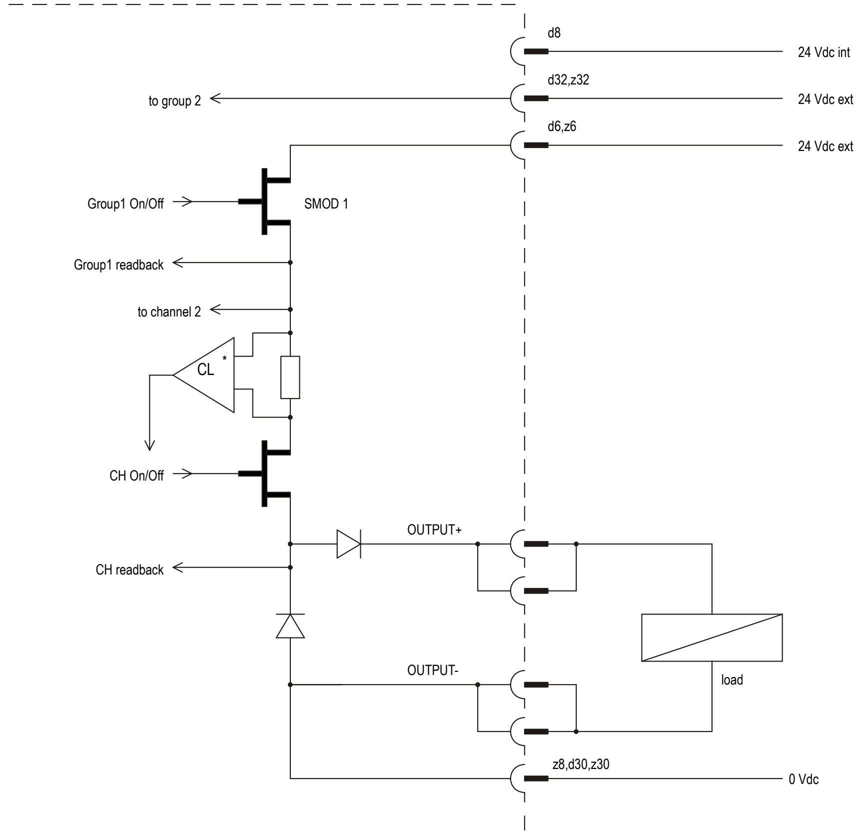
Within the configured Diagnostic Test Interval, the outputs are tested for:

- Ability to de-energize the output,
- Ability to de-energize the group (via secondary means),
- Crosstalk between outputs, and
- Functioning of the suppression diodes.

The external 24 Vdc supply is split into two groups of two outputs each. Each group has its own secondary means of de-energizing. This increases the shutdown selectivity in case of a channel failure.

A secondary means of de-energizing (SMOD) enables the watchdog and the processor to de-energize the outputs, irrespective of the result of the application function.

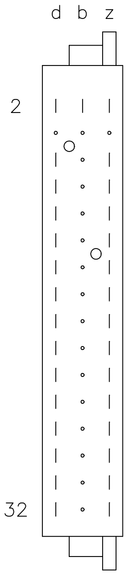
Figure 235 Schematic diagram for connection of one output to the SDO-0424 module



*Current Limiting circuit

Pin allocation

The back view and pin allocation of the SDO-0424 module connector are as follows:



d2	WDG	b2	GND	z2	VCC
d4	–			z4	–
d6	Supply 24 Vdc ext.			z6	Supply 24 Vdc ext.
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10				z10	
d12	OUT 1+			z12	OUT 1–
d14	OUT 1+			z14	OUT 1–
d16	OUT 2+			z16	OUT 2–
d18	OUT 2+			z18	OUT 2–
d20	OUT 3+			z20	OUT 3–
d22	OUT 3+			z22	OUT 3–
d24	OUT 4+			z24	OUT 4–
d26	OUT 4+			z26	OUT 4–
d28	(0 Vdc)			z28	(0 Vdc)
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32	Supply 24 Vdc ext.			z32	Supply 24 Vdc ext.

Connection examples

The figures below show a number of connection examples for the safe digital output module SDO-0424.

Figure 236 Connection example of SDO-0424 module to FTA for both non-redundant and redundant IO configurations

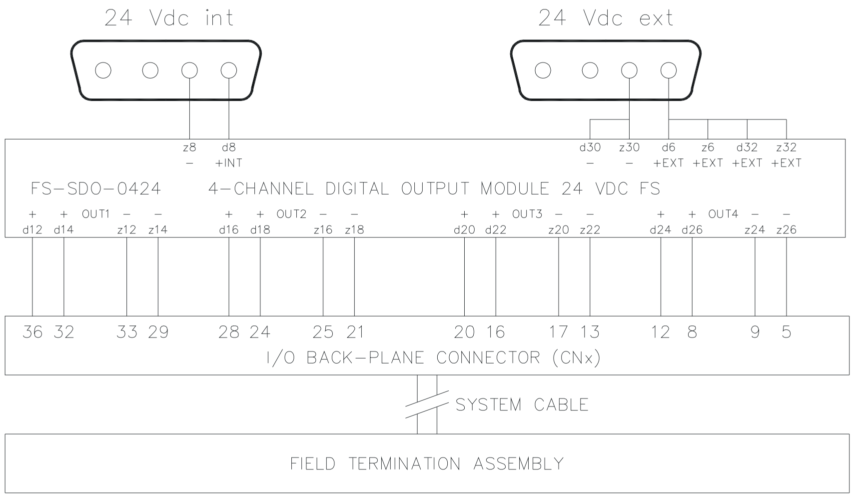


Figure 237 IO connection example for SDO-0424 module for non-redundant IO configurations

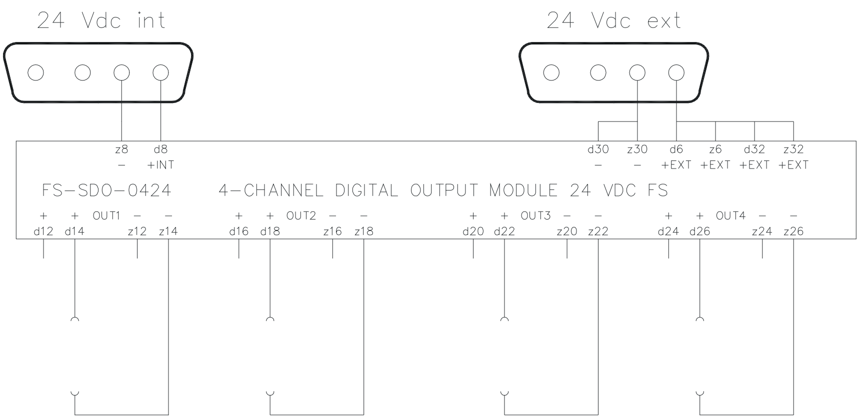
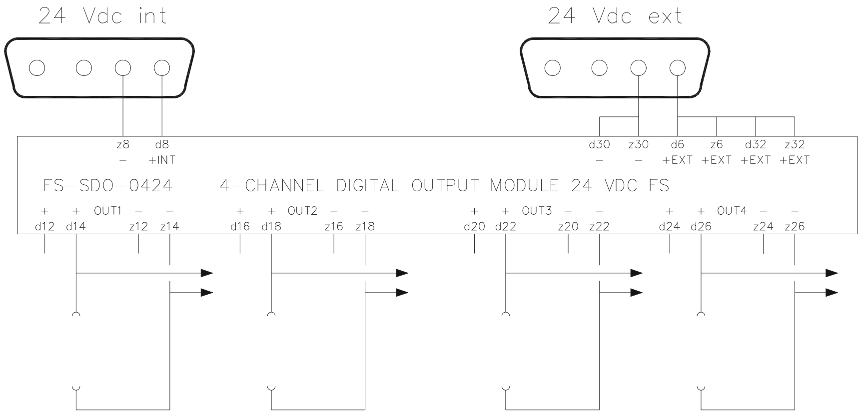


Figure 238 IO connection example for SDO-0424 module for redundant IO configurations



Note

The 24 Vdc internal and external power supplies must be connected to both output groups to prevent fault detection during self-testing of the output module (pins d6/z6, d8, d30/z30 and d32/z32)

Technical data

The SDO-0424 module has the following specifications:

General	Type numbers[1 2]:	FS-SDO-0424 V1.1
		FC-SDO-0424 CCV1.1
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 12 mA 24 Vdc internal, 35 mA 24 Vdc external, 50 mA (without output load)
Output	Number of output channels:	4 (2 groups of 2)
	Output specification:	24 Vdc solid-state source, short-circuit proof
	Maximum channel current:	2 A[3] (see “General information about output modules” on page 344)
	Maximum total module load:	6 A (module dissipation limit)
	Maximum lamp load:	417 mA (10 W)
	Maximum load capacitance:	1 µF
	Voltage drop:	< 1.3 Vdc at 2 A
	Off current:	< 0.1 mA
	WDG input current:	8 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A13, C5
	Chassis code:	
	• Large pins	A13, C5

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 have an improved design. There are no functional changes besides the operational limits stated herein.

3 The maximum output current is to be linear derated from 100% at 60°C (140°F) to 50% at 70°C (158°F).

SDOL-0424

Safe loop-monitored digital output module (24 Vdc, 1 A, 4 channels)

Description

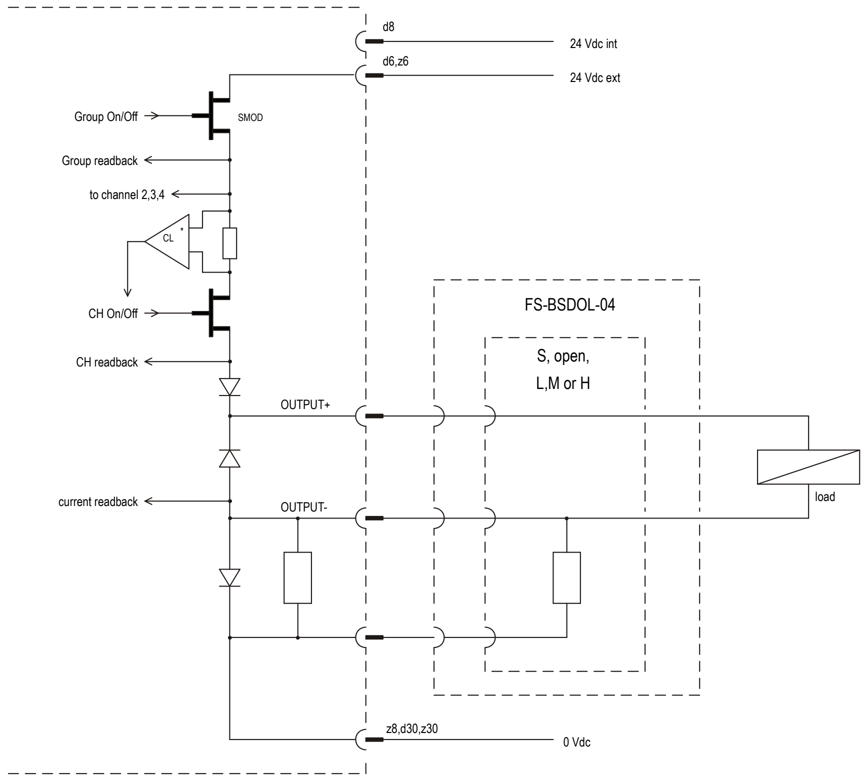
The safe loop-monitored digital output module SDOL-0424 has four 24 Vdc, 1 A loop-monitored output channels to drive loads up to 24 W. The maximum module load is 3.6 A. These loads may be resistive or inductive. For inductive loads, a suppression diode is included on each output.

The outputs, including the suppression diode, the lead breakage detection and short-circuit detection, are fully tested and may therefore be used for safe applications.

The outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Cross talk between outputs
- Function of the suppression diodes
- Lead breakage in the (external) output wiring
- Short circuit of the outputs

Figure 239 Schematic diagram for connection of one output to the SDOL-0424 module



*Current Limiting circuit

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and/or the processor to de-energize the outputs irrespective of the result of the application function.

Note

The SDOL-0424 module can only be used in combination with an IO backplane, since the outputs require an BSDOL-04UNI module.

Loop-monitoring

All outputs are monitored for lead breakage and short circuit. To get a rough lead breakage current setting, the current sense level must be programmed (see Table 54 on page 396). A BSDOL-04UNI module consists of a BSDOL-01 section, placed on the IO-backplane program connector PX and sixteen (4xS, 4xL, 4xM, 4xH) range setting sub-modules.

Table 54 Selection of range-setting module

LOAD		Range-setting module
Spare channel		Sub-module “S”
0.1—0.39 W	4—16 mA	None
0.4—1.1 W	17—47 mA	Sub-module “L”
1.2—4.7 W	48—199 mA	Sub-module “M”
≥ 4.8 W	≥ 200 mA	Sub-module “H”

LEDs

The SDOL-0424 module has one LED for each channel; four in total.

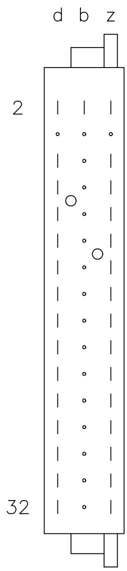
If a channel is **Off**, its corresponding LED is off and gives short intermittent flashes. These indicate the lead breakage tests are being performed.

If a channel is **On** and the configuration is **non-redundant**, its corresponding LED is on and gives (very) short periodic flashes, which are hardly visible to the naked eye. These indicate the internal switch-off self-tests are being performed.

If a channel is **On** and the configuration is **redundant**, its corresponding LEDs appear to flash intermittently. This happens because the module in Control Processor 2 switches off briefly to allow the module in Control Processor 1 to perform its self-test. After the self-test of the module in Control Processor 1 has been completed, the module in Control Processor 2 switches on again (this may take some time) and the module in Control Processor 1 switches off to allow the module in Control Processor 2 to perform its self-test, etc. Due to this, it looks as if the channel LEDs of both modules flash intermittently. The LED flash speed may vary, depending on the application cycle time and configuration of Diagnostic Test Interval.

Pin allocation

The back view and pin allocation of the SDOL-0424 module connector are as follows:

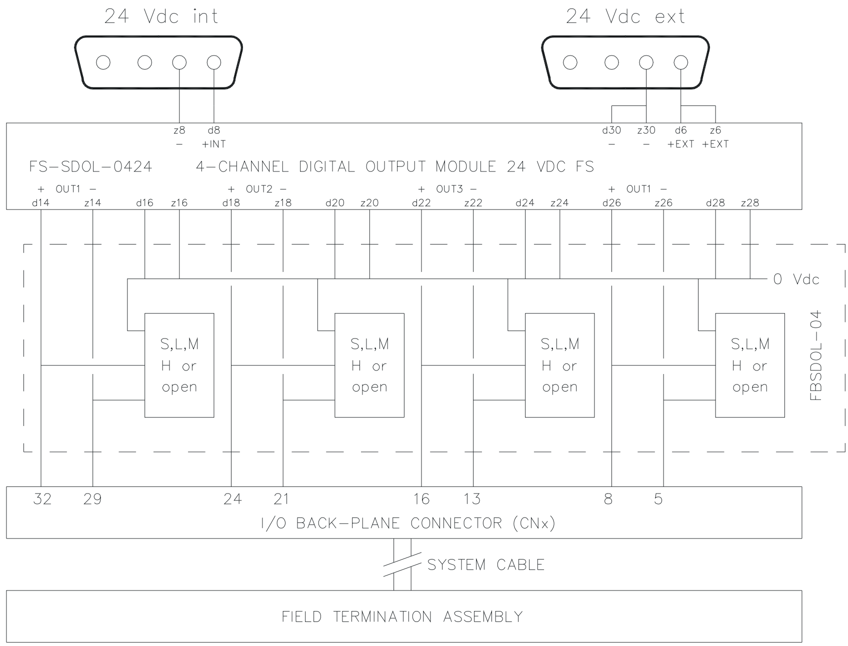


d2	WDG	b2	GND	z2	VCC
d4	–			z4	–
d6	Supply 24 Vdc ext.			z6	Supply 24 Vdc ext.
d8	Supply 24 Vdc int.			z8	Supply 0 Vdc
d10				z10	
d12	(0 Vdc)			z12	(0 Vdc)
d14	OUT 1+			z14	OUT 1–
d16	0 Vdc			z16	0 Vdc
d18	OUT 2+			z18	OUT 2–
d20	0 Vdc			z20	0 Vdc
d22	OUT 3+			z22	OUT 3–
d24	0 Vdc			z24	0 Vdc
d26	OUT 4+			z26	OUT 4–
d28	0 Vdc			z28	0 Vdc
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32				z32	

Connection example

The figure below shows a connection example for the safe digital output module SDOL-0424.

Figure 240 Connection example of SDOL-0424 module to FTA for both non-redundant and redundant IO configurations



Note

The 24 Vdc internal power supply (d8 and z8) must be connected to prevent fault detection during the self-test of the output module. The external power supply (d6/z6 and d30/z30), as well as (dummy) loads on all channels, must be connected to prevent fault detection during the lead breakage test of the output module.

Technical data

The SDOL-0424 module has the following specifications:

General	Type numbers[1 2]:	FS-SDOL-0424 V1.1
		FC-SDOL-0424 CCV1.1
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 15 mA 24 Vdc internal, 50 mA 24 Vdc external, 15 mA (without output load)
Output	Number of output channels:	4
	Output specification:	24 Vdc solid-state source, short circuit proof
	Maximum channel current:	1 A
	Maximum total module load:	3.6 A (module dissipation limit)
	Maximum load inductance:	0.5 H
	Maximum load capacitance:	1 µF
	Top of overload detection:	> 10 Ω
	Cold resistance lamp:	> 20 Ω
	Voltage drop:	< 1.3 V at 1 A
	Off current:	< 0.1 mA
	Current sense voltage drop:	< 1 V at 1 A
	WDG input current:	4 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A13, C9
	Chassis code:	
	• Large pins	A13, C9

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have improved design. There are no functional changes.

SDOL-0448

Safe loop-monitored digital output module (48 Vdc, 500mA, 4 channels)

Description

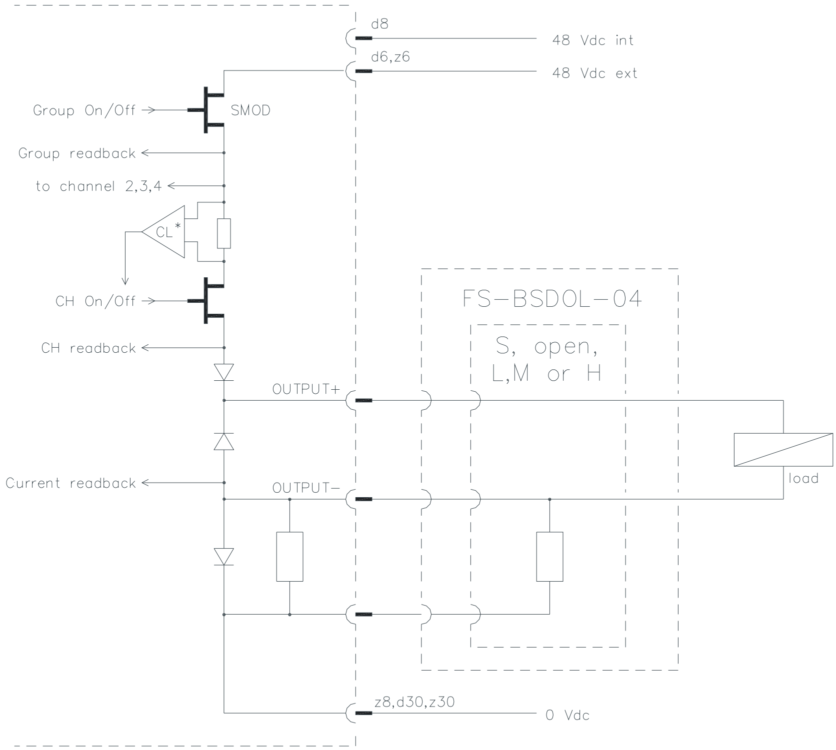
The safe loop-monitored digital output module SDOL-0448 has four 48 Vdc, 500mA loop-monitored output channels to drive loads up to 24 W. These loads may be resistive or inductive. For inductive loads, a suppression diode is included on each output.

The outputs, including the suppression diode, the lead breakage detection and short-circuit detection, are fully tested and may therefore be used for safe applications.

The outputs are tested for:

- Ability to de-energize
- Ability to de-energize via secondary means
- Cross talk between outputs
- Function of the suppression diodes
- Lead breakage in the (external) output wiring
- Short circuit of the outputs

Figure 241 Schematic diagram for connection of one output to the SDOL-0448 module



*Current Limiting circuit

The outputs have secondary means of de-energizing (SMOD). This enables the watchdog and/or the processor to de-energize the outputs irrespective of the result of the application function.

Note

The SDOL-0448 module can only be used in combination with an IO backplane, since the outputs require an BSDOL-04UNI module.

Loop-monitoring

All outputs are monitored for lead breakage and short circuit. To get a rough lead breakage current setting, the current sense level must be programmed (see Table 55 on page 402). A BSDOL-04UNI module consists of a BSDOL-01 section, placed on the IO-backplane program connector PX and sixteen (4xS, 4xL, 4xM, 4xH) range setting sub-modules.

Table 55 Selection of range-setting module

LOAD		Range-setting module
Spare channel[1]		Sub-module “S”
0.2—0.8 W	4—16 mA	None
0.9—2.2 W	17—47 mA	Sub-module “L”
2.3—9.5 W	48—199 mA	Sub-module “M”
≥ 9.6W	≥ 200 mA	Sub-module “H”

1 To reduce power consumption and heat dissipation it is advised to keep spare channels `Off`.

LEDs

The SDOL-0448 module has one LED for each channel; four in total.

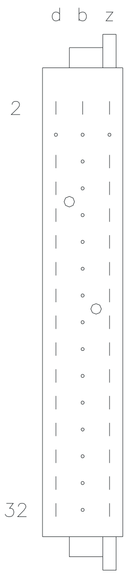
If a channel is **Off**, its corresponding LED is off and gives short intermittent flashes. These indicate the lead breakage tests are being performed.

If a channel is **On** and the configuration is **non-redundant**, its corresponding LED is on and gives (very) short periodic flashes, which are hardly visible to the naked eye. These indicate the internal switch-off self-tests are being performed.

If a channel is **On** and the configuration is **redundant**, its corresponding LEDs appear to flash intermittently. This happens because the module in Control Processor 2 switches off briefly to allow the module in Control Processor 1 to perform its self-test. After the self-test of the module in Control Processor 1 has been completed, the module in Control Processor 2 switches on again (this may take some time) and the module in Control Processor 1 switches off to allow the module in Control Processor 2 to perform its self-test, etc. Due to this, it looks as if the channel LEDs of both modules flash intermittently. The LED flash speed may vary, depending on the application cycle time and configuration of Diagnostic Test Interval.

Pin allocation

The back view and pin allocation of the SDOL-0448 module connector are as follows:

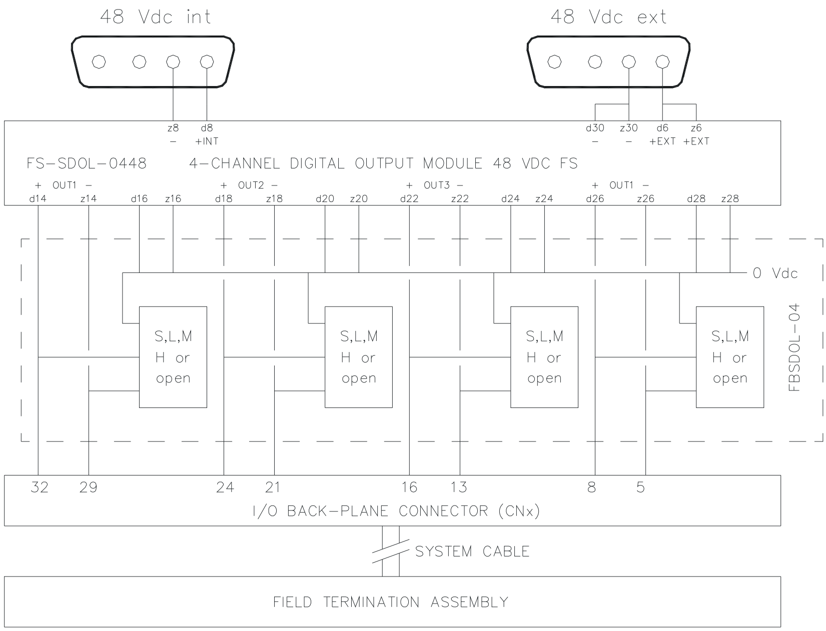


d2	WDG	b2	GND	z2	VCC
d4	–			z4	–
d6	Supply 48 Vdc ext.			z6	Supply 48 Vdc ext.
d8	Supply 48 Vdc int.			z8	Supply 0 Vdc
d10				z10	
d12	(0 Vdc)			z12	(0 Vdc)
d14	OUT 1+			z14	OUT 1–
d16	0 Vdc			z16	0 Vdc
d18	OUT 2+			z18	OUT 2–
d20	0 Vdc			z20	0 Vdc
d22	OUT 3+			z22	OUT 3–
d24	0 Vdc			z24	0 Vdc
d26	OUT 4+			z26	OUT 4–
d28	0 Vdc			z28	0 Vdc
d30	Supply 0 Vdc			z30	Supply 0 Vdc
d32				z32	

Connection example

The figure below shows a connection example for the safe digital output module SDOL-0448.

Figure 242 Connection example of SDOL-0448 module to FTA for both non-redundant and redundant IO configurations



Note

The 48 Vdc internal power supply (d8 and z8) must be connected to prevent fault detection during the self-test of the output module. The external power supply (d6/z6 and d30/z30), as well as (dummy) loads on all channels, must be connected to prevent fault detection during the lead breakage test of the output module.

Technical data

The SDOL-0448 module has the following specifications:

General	Type number[1] :	FS-SDOL-0448 V1.0
		FC-SDOL-0448 CCV1.0
	Approvals:	CE, TUV, UL, CSA
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 15 mA 48 Vdc internal, 25 mA 48Vdc external, 15 mA (without output load)
Output	Number of output channels:	4
	Output specification:	48 Vdc solid-state source, short circuit proof
	Maximum channel current:	0.5 A (see section “General information about output modules” on page 344)
	Maximum load inductance:	1 H
	Maximum load capacitance:	0.5 µF
	Top of overload detection:	> 50 Ω
	Cold resistance lamp:	> 90 Ω
	Voltage drop:	< 1.5 V at 0.5A
	`Off` current:	< 0.1 mA
	Current sense voltage drop:	< 1 V at 0.5A
	WDG input current:	4 mA
Key coding	(See section “Key coding” on page 17)	
	Module code:	
	• Holes	A17, C9
	Chassis code:	
	• Large pins	A17, C9

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

Output converter modules

11

This chapter describes the output converter modules that are available for Safety Manager.

The following output converter modules are described:

Output converter module		See
BSDOL-04UNI setting "S" setting "L" setting "M" setting "H"	Range setting module	page 410

For related output modules, see "Output modules" on page 343.

General info about output converter modules

An output converter module converts (output) load ranges to values that can be used by Safety Manager output module signals.

The converter modules described here are “B” type converters, meaning they are placed on an IO programming connector on the IO backplane in the IO chassis.

Table 56 on page 408 shows the available output converter modules and the output modules for which they are used.

Table 56 output converter modules and their corresponding output modules

Output Converter Module	Output Module
BSDOL-04UNI	SDOL-0424

Figure 243 on page 408 shows a part of the back of a non-redundant IO chassis with input converters in slots P1, P4, P6 and P7.

Figure 243 Detail of the back of a non-redundant IO chassis

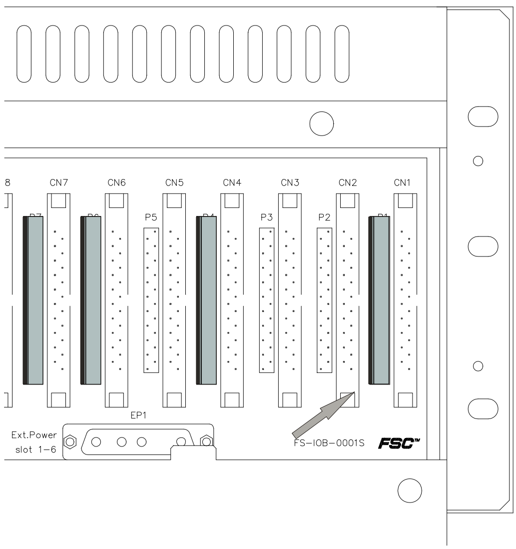
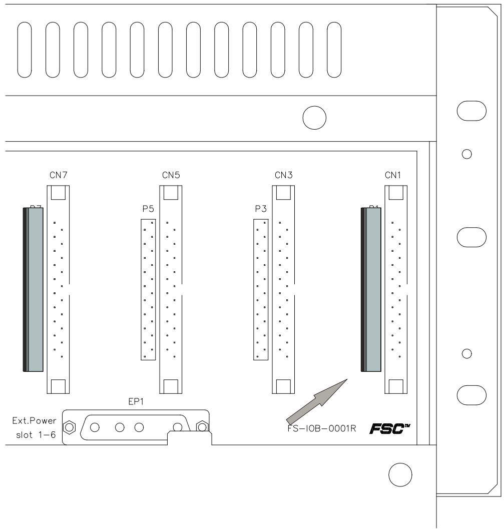


Figure 244 on page 409 shows a part of the back of a redundant IO chassis with output converters in slots P1 and P7.

Figure 244 Detail of the back of a redundant IO chassis



BSDOL-04UNI

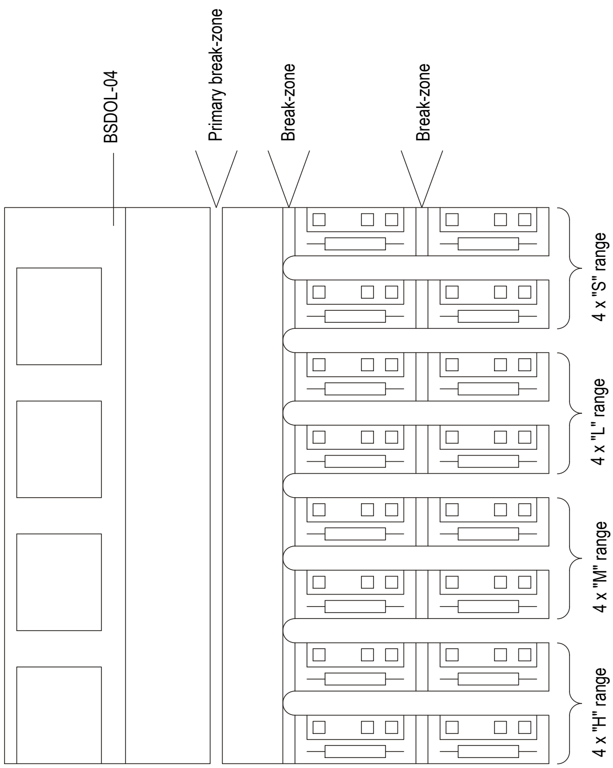
Range setting module

Description

The loop-monitored output channels of the SDOL-0424 module usually need a range setting module to put the current sense level in the proper range or to prevent lead breakage detection on spare channels. For this, the range setting module BSDOL-04UNI can be used.
Redundant SDOL-0424 modules require only one BSDOL-04UNI module.

The BSDOL-04UNI module is placed on a programming connector (Px) on the back of the IO backplane in the 19-inch chassis.

Figure 245 Front view of the BSDOL-04UNI



The BSDOL-04UNI module is a module with break-off sections (see Figure 245 on page 410):

- The main section (BSDOL-04), which must be placed on the programming connector (Px) on the IO backplane. Offers 4 range settings positions for channel 1 through 4 (see Table 57 on page 411).
- 16 Range setting sub-modules (4x type S, 4x type L, 4x type M, 4x type H), which must be placed on the 4 positions in the BSDOL-04 (= main section).

Table 57 on page 411 shows the possible range settings for the BSDOL-04UNI module.

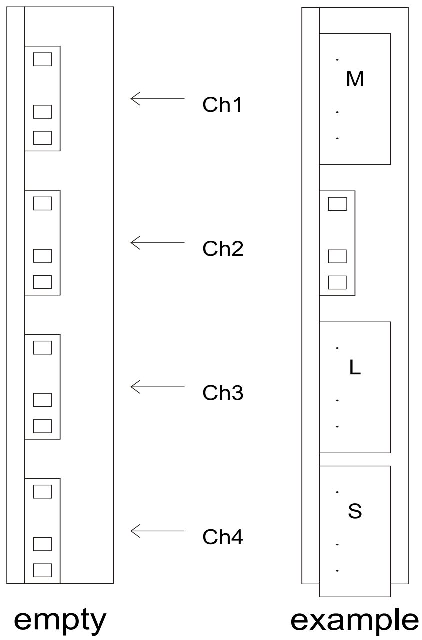
Table 57 Possible BSDOL-04UNI range settings

Range setting	Range	Description
S	-	The BSDOL-04UNI “S” range setting is used for spare channels of SDOL-04x modules to prevent lead breakage detection on those channels and has a 4.7 kΩ (dummy load) resistor.
L	17—47 mA	The BSDOL-04UNI “L” range setting module is used for SDOL-04x channels with loads between 17 and 47 mA and has a 33 Ω resistor to set the current sense level.
M	48—199 mA	The BSDOL-04UNI “M” range setting module is used for SDOL-04x channels with loads between 48 and 199 mA and has a 10 Ω resistor to set the current sense level.
H	≥ 200 mA	The BSDOL-04UNI “H” range setting module is used for SDOL-04x channels with loads of 200 mA or higher and has a 2.2 Ω resistor to set the current sense level.

Note

When the BSDOL-04UNI module is placed on the IO backplane, the top position corresponds to channel 1, the second position to channel 2, and so on.

Figure 246 Rear view of an BSDOL-04UNI on an IO backplane



The ‘example’ in Figure 246 on page 412 shows:

- Channel 1: setting for a 48—199 mA load
- Channel 2: setting for a 4—16 mA load
- Channel 3: setting for a 17—47 mA load
- Channel 4: spare

The ‘empty’ BSDOL-04UNI at the left side in Figure 246 on page 412 is actually set for 4—16 mA load on all four channels.

Figure 247 Schematic diagram for a channel with range setting sub-module

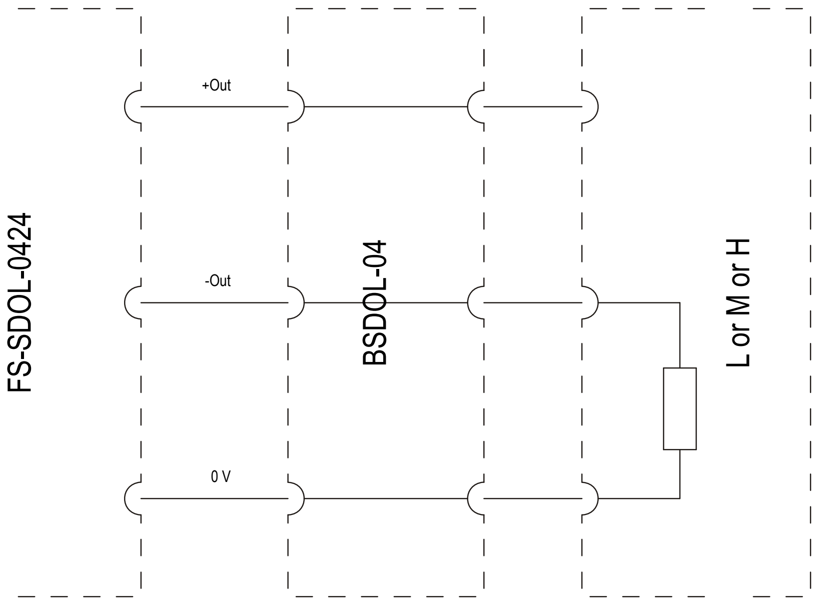
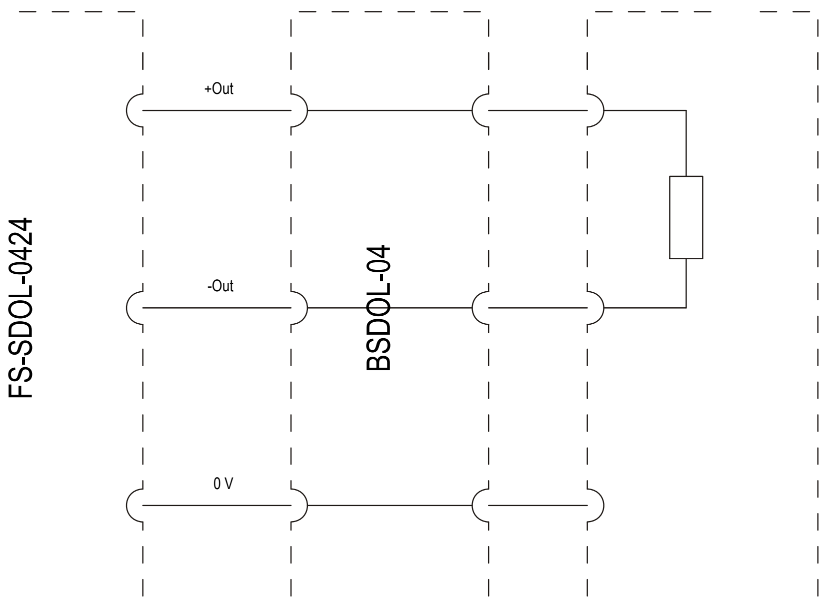


Figure 248 Schematic diagram for a spare channel



Technical data

The BSDOL-04UNI module has the following specifications:

General	Type numbers[1] :	FS-BSDOL-04UNI
		FC-BSDOL-04UNI
	Approvals:	CE, TUV, UL, CSA, FM
	Number of channels:	4
Power	Power requirements:	
	“S”	5 mA from 24 Vext. of SDOL-0424
	“L”, M” and “H”	None
	Load range:	
	“S”	None
	None	4—16 mA 0.1—0.39W at 24 Vdc (SDOL-0424)
	“L”	17—47 mA 0.4—1.1 W at 24 Vdc (SDOL-0424)
	“M”	48—199 mA 1.2—4.7 W at 24 Vdc (SDOL-0424)
	“H”	≥ 200 mA ≥ 4.8 W at 24 Vdc (SDOL-0424)
Physical	Dimensions: BSDOL-04UNI BSDOL-04 Range setting sub-module	 58.5 × 54.5 × 12.5mm (2.3 × 2.15 × 0.5 in) 58.5 × 21 × 9mm (2.3 × 0.825 × 0.35 in) 13.5 × 5.1 × 12.5mm (.525 × 0.2 × 0.5 in)
	Chassis space requirements:	None (placed on programming connector on IO backplane)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

12 Universal IO modules

This chapter describes the universal IO modules that are available for Safety Manager. These are:

output module		see
RUSIO-3224	Remote Universal Safe IO device (32 channels, 24 Vdc)	page 416
RUSLS-3224	Remote Universal Safe Logic Solver (32 channels, 24 Vdc)	page 439

RUSIO-3224

Remote Universal Safe IO device (32 channels, 24 Vdc)

Description

The RUSIO-3224 module has 32 universal safe IO channels with configurable channel function; configuration is done in Safety Builder.
The RUSIO-3224 module can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

It requires two RUSIO-3224 modules to achieve a redundant configuration.

All channels are powered out of the 24Vdc supply.

Each channel can be configured as:

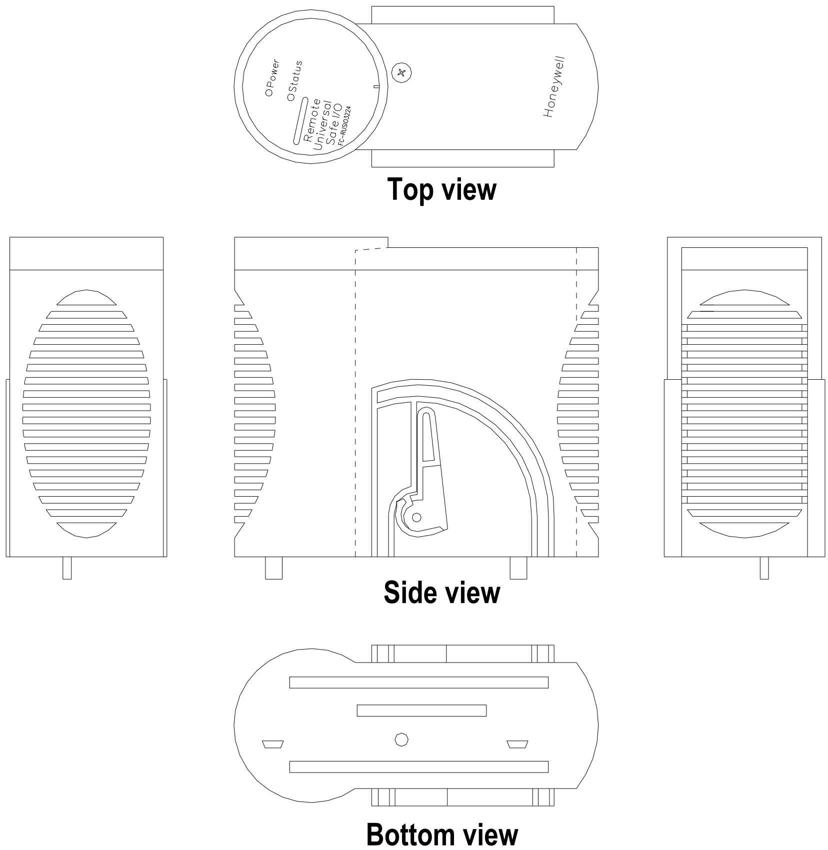
- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring)
- Analog input (0-20mA or 4-20mA active)
- Analog output (0-20mA or 4-20mA active)

The RUSIO-3224 module supports two (100Mbaud) ethernet links to communicate with a SM Controller.

The RUSIO-3224 module has a housing that is in line with the patented Series C design of Honeywell. It needs to be placed on an IO Termination Assembly (IOTA).

Figure 249 on page 417 shows physical appearance of the RUSIO-3224 module.

Figure 249 RUSIO-3224 module - top, side and bottom view



The RUSIO-3224 module has the following features:

- 32 universal IO channels that can be configured to control DI, AI, DO, AO
- any type of IO field signal has only to be connected to the two connections of the applicable universal channel on the IOTA
- proven-in-use redundant processor concept that complies with the SIL 3 safety requirements in single channel operation
- a dedicated communication link between these processors
- a redundant communication link with the partner module (in redundant configuration)
- an Ethernet-based SM RIO link to the SM Controller in the network via dedicated switches; the SM RIO link uses a dedicated protocol

- monitoring the temperature of the electronics
- a configurable ESD function via channel 32 for dedicated safety related functions
- function-tested watchdogs that: monitor and/or handle:
  - monitor cycle time and supply voltage
  - handle the ESD function and memory errors
- LED indicators at the front of the module for power and health status indication
- real-time clock for Sequence Of Event (SOE) time stamping with a resolution of 1 msec

The RUSIO-3224 module functions as a universal IO module within the Safety Manager concept. It executes:

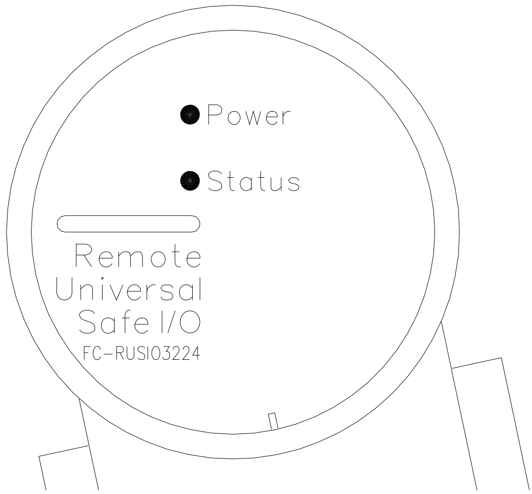
- the input scan of the process variables
- all functional tests of its hardware
- data exchange with its partner module
- data exchange via the SM RIO link with the SM Controller that executes the application logics
- update the outputs and thus the process

The FLASH nature of the memory allows for on line upgrading within the TUV-approved concept of both the system software as well as the channel configuration.

Power and status indications

The RUSIO-3224 module has two LEDs; one for power indication and one for status indication (see Figure 250 on page 419).

Figure 250 RUSIO-3224 module - power and status indications



The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

ESD function

The RUSIO-3224 module has one channel that can be configured as Emergency ShutDown (ESD) input; this is channel 32. To configure channel 32 as ESD input in Safety Builder, the two pins fork on the **CN4** terminals on the IOTA must be in the **ENABLE** position (connecting pins 1 and 2).

Channel 32 must be configured for the ESD function in the software also, in order to execute the proper tests for the ESD channel.

When the (field) switch on the ESD input opens, the universal IO watchdogs switch off and all digital outputs of the connected RUSIO-3224 module(s) will go off and remain off. There is *no* software action required to do this; also there is *no* software action that can prevent this.

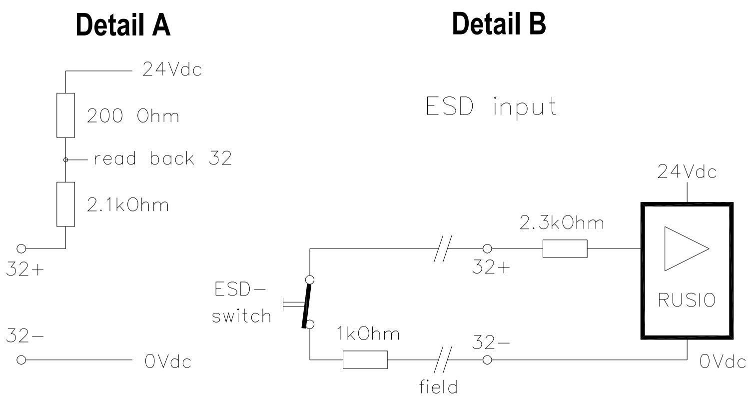
See detail A of Figure 251 on page 420 for a block diagram of this ESD input.

See detail B of Figure 251 on page 420 for the ESD input field connection.

The ESD input is line monitored (for short circuit in the field wires).

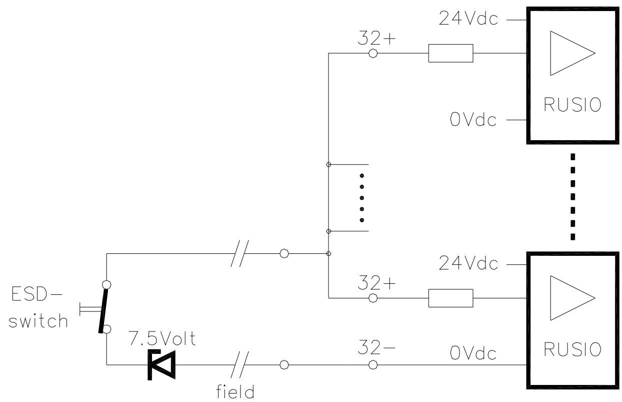
Place the (1kOhm) line termination resistor on (or near) the switch.

Figure 251 ESD input of a universal IO channel



Connecting multiple ESD-inputs of RUSIO-3224 modules with one switch requires a 7.5Volt zener, see Figure 252 on page 421.
All RUSIO-3224 modules involved must be supplied out of the same 24Vdc (power rail).
A 1 Watt zenerdiode - like the 1N4737A or the BZV85-C7V5 - can handle upto 10 ESD inputs of (redundant) RUSIO-3224 modules.
A 5 Watt zenerdiode - like the 1N5343B - can handle upto 50 ESD inputs of (redundant) RUSIO-3224 modules.

Figure 252 ESD switch to multiple universal IO modules



Technical Data for an ESD input

Open voltage:	24 Vdc -20% ... +30%
Closed contact current:	7 mA ± 5% (at 24Vdc)
Switch resistor (single):	1 kOhm ± 5% >0.25W
Switch zener (multiple):	7.5 Volt
Open contact current:	< 4 mA ± 5%
Short circuit detection:	field resistance < 500 Ohm ± 50%
ESD to outputs off delay:	10 ms ± 30%

IO channels

The RUSIO-3224 module has 32 remote universal safe IO channels.

One RUSIO-3224 module can be placed on a non-redundant IOTA to establish 32 non-redundant channels. Two RUSIO-3224 modules can be placed on one redundant IOTA to establish 32 redundant universal safe IO channels.

Each channel has two screw positions for the connection of field wires on the IOTA. No additional connections for field devices are required.

Positions 1+ thru 32+ are the signal connections; one for each of the channels.

Positions 1- thru 32- are (all) directly connected with the 0Volt supply connection.

All channels are 24Vdc sourcing (“active”).

Each channel can be configured as (line monitored) input or output. Some channels have additional configuration features. In the next topics the features and specific technical data of the various configurations are described. The topic titles reflect the function that a channel will have once it is configured.

Line-monitored digital input

The line-monitored input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 253 on page 423 for a block diagram of this universal IO channel configuration.

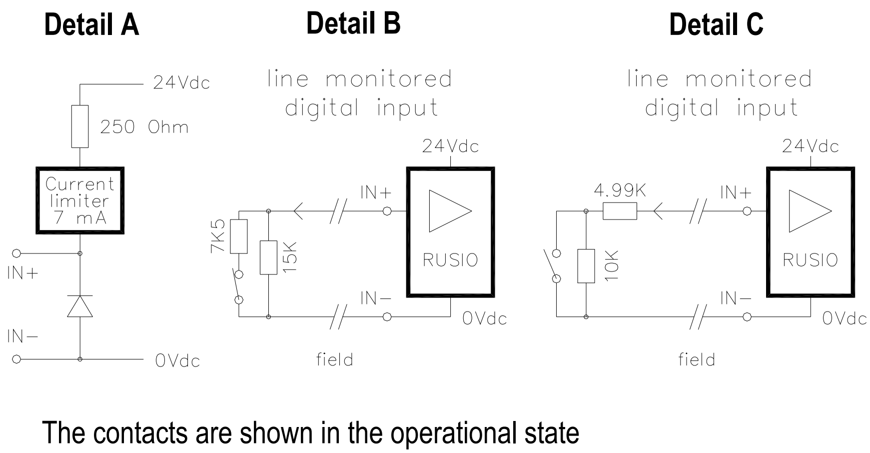
A line-monitored digital input requires two resistors in the field, near the switching element.

For Normally Closed (field-)contacts, these resistors must be connected in parallel, close to the switch. See detail B of Figure 253 on page 423.

For Normally Open (field-)contacts, these resistors must be connected in series, close to the switch. See detail C of Figure 253 on page 423.

Lead-breakage or short circuit in the wires to the switching element will be detected and result in a warning by the RUSIO-3224.

Figure 253 Line-monitored digital input of a universal IO channel



Technical Data for a line-monitored digital input

All channels	Open voltage:	24 Vdc -20% ... +30%
	Short circuit current:	7 mA ± 5%
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Open contact:	15 kOhm ± 5% >0.1W
	Closed contact:	5 kOhm ± 5% >0.25W
	Short circuit detection:	I > 6.3 mA ± 5%
	Closed contact detection:	2.8 mA < I < 6.3 mA ± 5%
	Open contact detection:	0.7 mA < I < 2.1 mA ± 5%
	Lead breakage detection:	I < 0.7 mA ± 5%
	Input filter:	first-order low-pass 100 Hz

Non line-monitored digital input

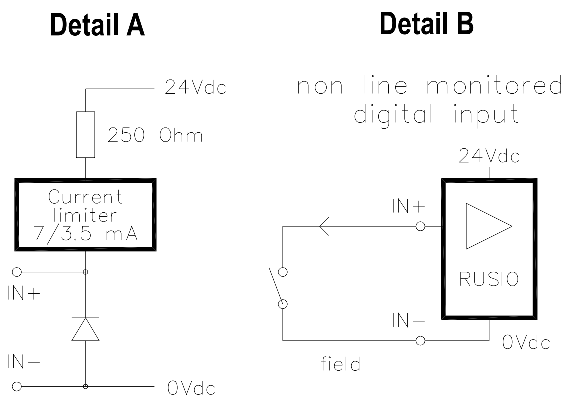
The non line-monitored input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 254 on page 424 for a block diagram of this universal IO channel configuration.

A non line-monitored digital input has a switching element in the field; see detail B of Figure 254 on page 424.
This input has no short circuit or lead breakage detection.

Attention:

Channels configured as non line-monitored digital inputs may not be used as part of a safety loop.

Figure 254 Non line-monitored digital input of a universal IO channel



Technical Data for a non line-monitored digital input

All channels	Open voltage:	24 Vdc -20% ... +30%
	Closed contact current:	7 mA ± 5%, after open state detection
		3.5 mA ± 5%, after closed state detection
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Closed contact detection:	I > 2.8 mA ± 5%
	Open contact detection:	I < 2.1 mA ± 5%
	Input filter:	first-order low-pass 100 Hz

Analog input 0-20mA and 4-20mA

The analog input of the RUSIO-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 255 on page 425 for a block diagram of this universal IO channel configuration.

An analog input is typically connected with a sensor in the field.
That sensor can also be a smoke or fire detector.
See details B and C of Figure 255 on page 425 for examples.

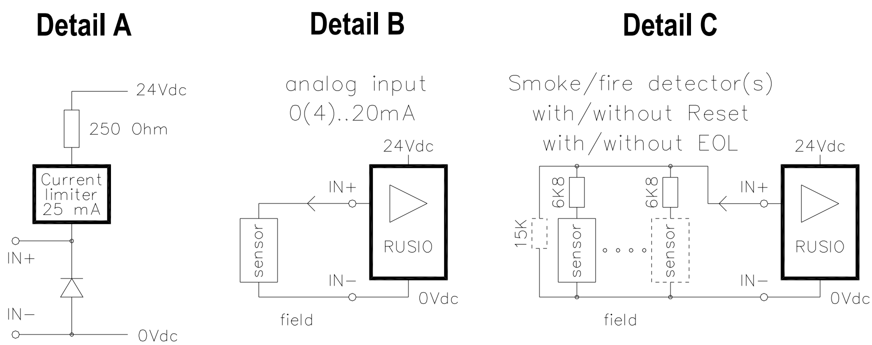
A latching smoke or fire detector can be reset by the RUSIO-3224 module without extra components or wires.
It is possible to connect multiple smoke or fire detectors (up to 6) on one channel.
Line monitoring and sensor state must be handled in the function block.
For a wiring example see detail C of Figure 255 on page 425.

An analog input can be configured for 0-20mA or 4-20mA and is always active (internally sourced out of the 24Vdc supply).

Short circuit in the wires to the sensor will be detected and result in a warning by the RUSIO-3224.

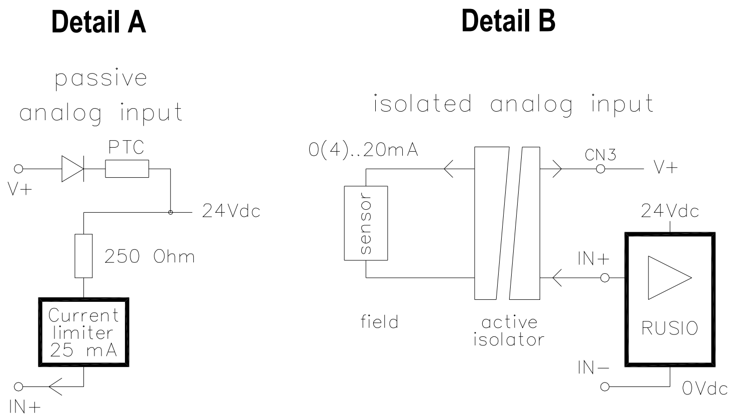
If the input is configured for 4-20mA, than lead breakage of the wires will also be detected and result in a warning by the RUSIO-3224 module.

Figure 255 Analog input of a universal IO channel



A passive analog universal IO input 0-20mA or 4-20mA can only be created if the current source is isolated. See detail A of Figure 256 on page 426 for a block diagram of this universal IO input.
Passive analog universal IO inputs use a V+ pin of **CN3** on the IOTA. See detail B of Figure 256 on page 426 for an example.

Figure 256 Passive analog input of a universal IO channel



Technical Data for an analog input

Open voltage:	24 Vdc -20% ... +30%
Field voltage:	> 15 Vdc (at 0 ... 24 mA)
Short circuit current:	24.5 mA ± 0.5 mA
Input range:	0-20mA or 4-20mA
Input impedance:	typically 250 Ohm
A-D conversion:	16 bit
Accuracy:	0.15% of full scale
Safety-related inaccuracy:	< 1% of full scale
Input filter:	first-order low-pass 100 Hz

Warning:

1. All active field devices shall be galvanically separated (isolated) from live voltages. Live voltages are voltages higher than 30Vac or 40Vdc.
2. Drawing more than 24 mA will cause extra heat dissipation in the housing of the RUSIO-3224 module. For more information refer to “Temperature derating” on page 430.

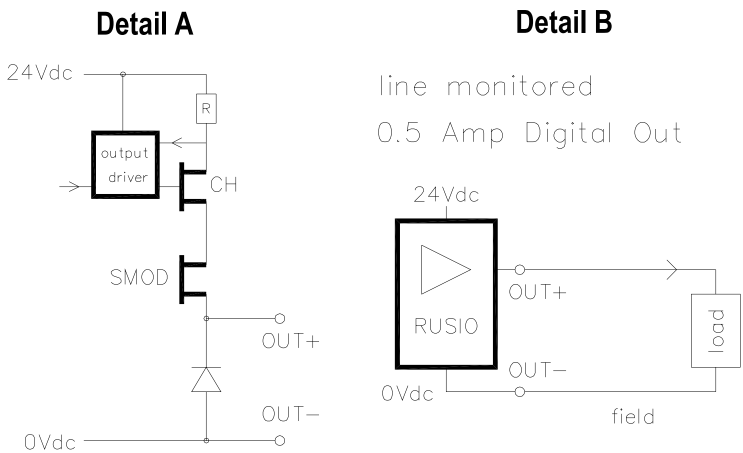
Digital output

The digital output of the RUSIO-3224 module consists of a (0.5 Amp current limited) output with a Secondary Means Of De-energisation (SMOD) FET output.
Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See detail A of Figure 257 on page 427 for an example.

The output driver limits the output (short circuit) current and switches off the output if an overload condition lasts too long.

All digital outputs are off when the universal IO watchdogs are tripped.

Figure 257 (Single) digital output of a universal IO channel



Lead breakage detection in the (field-) wiring is achieved by sourcing a small current (1 mA) into the field. Failure to conduct this current indicates lead breakage.

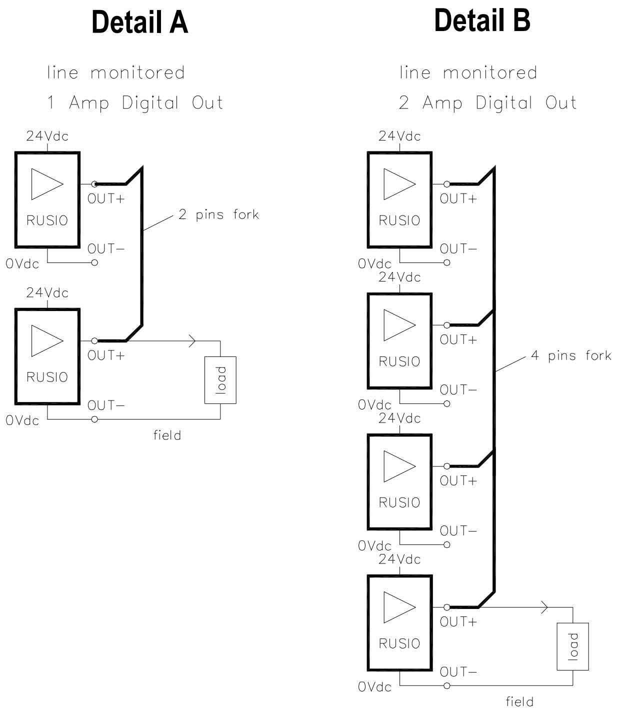
Loads of more than 0.5Amp are supported with the multiple output option.

Sets of two or four outputs can be configured as a multiple output, respectively capable of sourcing up to 1 Amp or 2 Amp.

A 2 pins fork with a pitch of 5.08mm (or a 4 pins fork with a pitch of 5.08mm) can be used to interconnect the multiple outputs. See details A and B of Figure 258 on page 428 for examples.

The field + wire must be connected with one of the OUT+ pins (together with the fork). Any one of the OUT- pins can be used to connect the field return wire.

Figure 258 Multiple digital output connection of a universal IO channel



Technical Data for a digital output

Output:	24 Vdc solid-state source
	short circuit proof
Maximum (resistive) load:	500 mA
	for more details see “General information about output modules” on page 344
Maximum tungsten-lamp load:	125mA (3 W)
Minimum load:	1 mA
Maximum load capacitance:	1 uF
Voltage drop:	< 1.5 V (at 500 mA)
Off current:	< 0.1 mA
Lead breakage test current:	approx. 5 mA
Two pins fork:	Weidmuller, LPA QB 2
Four pins fork:	Weidmuller, LPA QB 4

Analog output 0-20mA and 4-20mA

The analog output of the RUSIO-3224 module consists of a 250 Ohm readback resistor, a current control circuit with output FET (AO) and a SMOD FET. See detail A of Figure 259 on page 429 for a block diagram of this universal IO output.

An analog output is typically connected with an 0-20mA or 4-20mA analog actuator in the field. See detail B of Figure 259 on page 429 for an example.

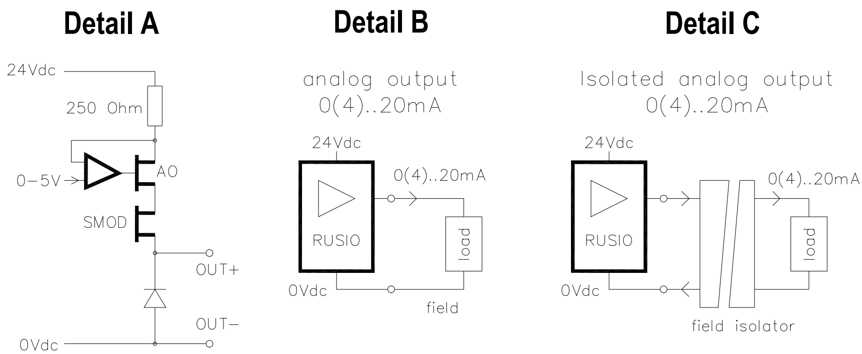
An analog output can be configured for 0-20mA or 4-20mA and is always active. This means that the RUSIO-3224 module provides the required power.

Short circuit in the wires to the load will not be detected.

If the output is configured for 4-20mA, than lead breakage of the wires will be detected and result in a warning by the RUSIO-3224 module.

Isolated analog output signals require an (Ex-)analog isolator module. See detail C of Figure 259 on page 429 for an example of how to connected such an output.

Figure 259 Analog output of a universal IO channel



Technical Data for an analog output

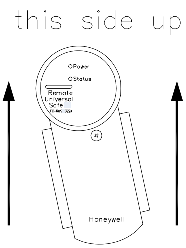
Open voltage:	24 Vdc -20% ... +30%
Output current:	0 - 23 mA
Field (loop) resistance:	max. 500 Ohm
D-A conversion:	12 bit
Accuracy:	0.15% of full scale
Safety-related inaccuracy	< 1% of full scale

Temperature derating

This sub section addresses ‘outside module temperature’. The maximum outside module temperature must be limited depending on the internal dissipation.

Attention:

1. Airflow in / through the module is assumed to be natural convection.
2. Make sure that RUSIO-3224 modules are installed in the correct position. A RUSIO-3224 module must be mounted in upright position (refer to the figure at the right).



To determine the maximum acceptable outside module temperature for a typical configuration do the steps below. Relevant details are given in separate topics.

Outline of the procedure	For details see
1 Perform the Internal dissipation calculation. **a.** Determine which supply voltage applies to your configuration: - 25V or less, - more than 25V or unknown. **b.** Select the applicable reference table. **c.** Determine and record the actual configuration data. **d.** Calculate the totals per dissipation contributor. **e.** Add the totals of the previous step to determine the internal dissipation.	page 431
2 Determine the maximum acceptable outside module temperature. Use the applicable derating curve, based on the supply voltage: • 25V or less: use the derating curve in Figure 260. • more than 25V or unknown: use the derating curve in Figure 261.	 page 433 page 435

Tip:

You can make a print of the applicable calculation table to make annotations of your specific configuration(s). Make sure to fill in the table for the applicable supply voltage.

Internal dissipation calculation

To calculate the maximum outside module temperature, you need the configuration. The maximum dissipation caused by the logic of the RUSIO-3224 module is a fixed value. Other dissipation contributions depend on the channel configuration. The maximum dissipation per channel type depends on the applicable supply voltage.

Select the appropriate table to carry out the calculation, based on the supply voltage:

- 25V or less: 25V (default) - Table 58 on page 431,
- more than 25V or unknown: 31.2V (maximum) - Table 59 on page 432.

Table 58 Dissipation calculation - supply voltage 25V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSIO [1]	0.49		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335		
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Table 59 Dissipation calculation - supply voltage 31.2V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSIO [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

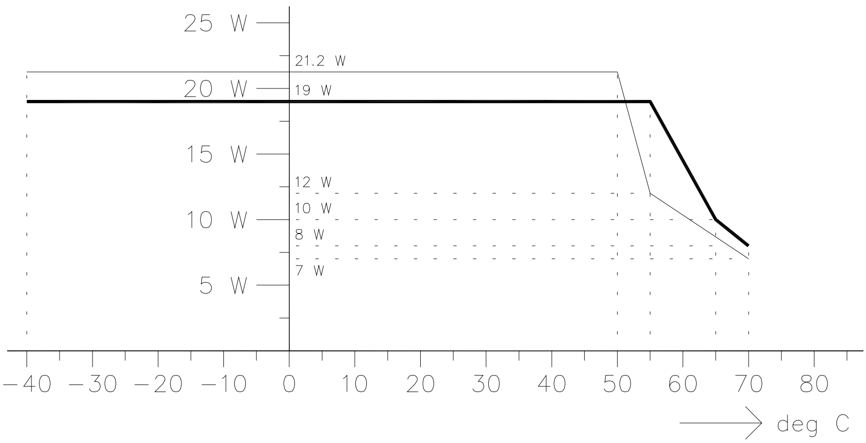
1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Temperature derating curves (25V supply voltage)

Figure 260 shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 25V supply voltage.

An example calculation for this supply voltage is given in Table 60 on page 434.

Figure 260 Module derating with a supply voltage of 25V default



Thick line: applicable for most applications having AO<=20mA and AI<=24mA

Thin line: applicable if one or more channels have AO>20mA or AI>24mA

Table 60 shows a calculation example using the table for a 25 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in Figure 260 on page 433 the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 70°C, with the **High temperature shutdown** of the module set at 90°C.

Note:

The maximum outside temperature limit can be improved with forced airflow.

Table 60 Example: dissipation calculation - supply voltage 25V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	10	0.1
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	10	0.5
AI; > 24 mA; Current limited by RUSIO [1]	0.49		
DO; <0.3 A	0.115	10	1.15
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335	2	0.67
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			**7.92**
Max. outside module temperature [°C]			**+ 70**

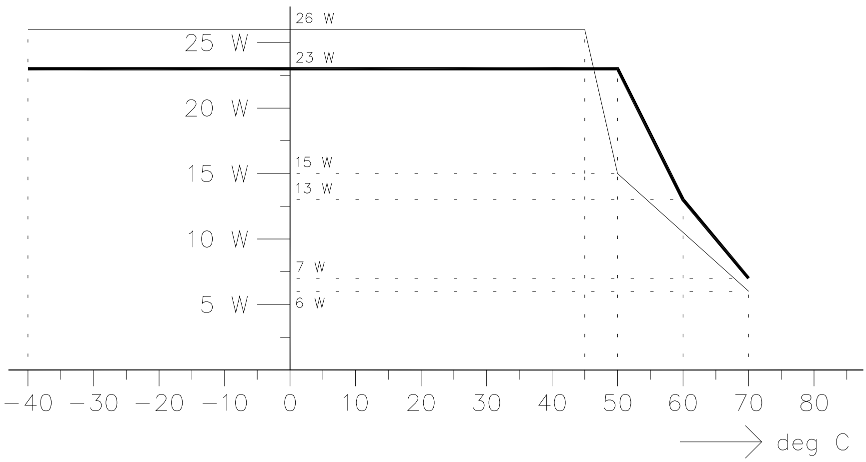
1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Temperature derating curves (31.2V supply voltage)

Figure 261 shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 31.2V supply voltage.

An example calculation for this supply voltage is given in Table 61 on page 436.

Figure 261 Module derating with a supply voltage of 31.2V



Thick line: applicable for most applications having AO<=20mA and AI<=24mA

Thin line: applicable if one or more channels have AO>20mA or AI>24mA

Table 61 shows a calculation example using the table for a 31.2 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in Figure 261 on page 435 the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 65°C, with the **High temperature shutdown** of the module set at 90°C.

Note:

The maximum outside temperature limit can be improved with forced airflow.

Table 61 Example: dissipation calculation - supply voltage 31.2V

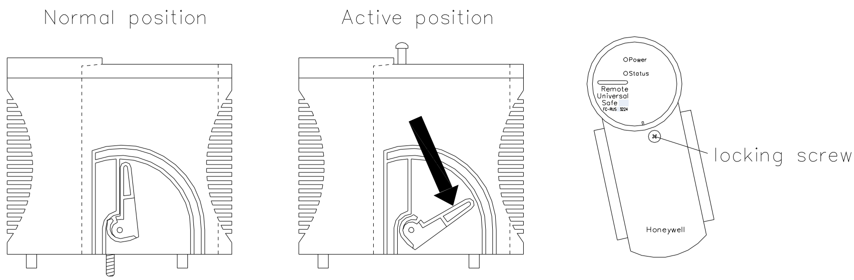
Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	2	0.02
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	21	1.05
AI; > 24 mA; Current limited by RUSIO [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305	9	2.75
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			**9.32**
Max. outside module temperature [°C]			**+ 65**

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Module handling - replacement

This sub section describes the procedures for removal and installation of a RUSIO-3224 module. See Figure 262 on page 437 for relevant details.

Figure 262 Module handling - removal lever



Removal of a RUSIO-3224 module

Do these steps in the order given to remove the subject RUSIO-3224 module:

1. On the IOTA, set the applicable switch (**POWER 1** or **POWER 2**) to **OFF**. The **Power** LED (green) must go off.
2. Completely loosen the locking screw.
3. Press both (removal) levers at the sides of the module down *at the same time*. See **Active Position** in Figure 262.
4. Remove the module from the IOTA.
5. Put the (removal) levers back in the upright (normal) position.

Installation of a RUSIO-3224 module

Do these steps in the order given to install the subject RUSIO-3224 module:

1. On the IOTA, make sure that the applicable switch (**POWER 1** or **POWER 2**) is set to **OFF**.
2. On the module to be installed, make sure that the (removal) levers are in the upright (normal) position.
3. Hold the module in the correct position on the IOTA and carefully push it down on the corresponding connectors.
4. Tighten the locking screw.
5. On the IOTA, set the applicable switch (**POWER 1** or **POWER 2**) to **ON**. The **Power** LED (green) must go on.

Technical data

The RUSIO-3224 module has the following specifications:

General	Type number:	FC-RUSIO-3224
	Operating temperature:	
	• outside module temperature:	–40°C ... +70°C (–40°F ... +158°F)
	• inside module temperature:	–40°C ... +90°C (–40°F ... +194°F)
	Storage temperature:	–40°C ... +85°C (–40°F ... +185°F)
	Relative humidity:	10 ... 95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV pending
Power	Supply voltage:	24 Vdc -15% ... +30%
	Supply current:	max 300mA (without field load)
IO	Number of channels:	32
	Channel type:	Universal safe (software configurable)
	• Digital in	max. 32 (with or without line-monitoring)
	• ESD in	max. 1 (with line-monitoring)
	• Analog in	max. 32 (with or without line-monitoring)
	• Digital out	max. 32 (with or without line-monitoring) max. combined load: 9 Amp
	• Analog out	max. 16 (with or without open loop detection)
Physical Data	Dimensions (H x W x D):	145 x 165.1 x 72.4 mm 5.7 x 6.5 x 2.85 in
	Weight:	0.66 kg 1.45 lbs

RUSLS-3224

Remote Universal Safe Logic Solver (32 channels, 24 Vdc)

Description

The RUSLS-3224 module has 32 universal safe IO channels with configurable channel function; configuration is done in Safety Builder.
The user can assign execution of application logics to the RUSLS-3224 module for one or more related FLDs; this is called logic solving. Configuration of logic solving is done in Safety Builder.
The RUSLS-3224 module can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

It requires two RUSLS-3224 modules to achieve a redundant configuration.

All channels are powered out of the 24Vdc supply.

Each channel can be configured as:

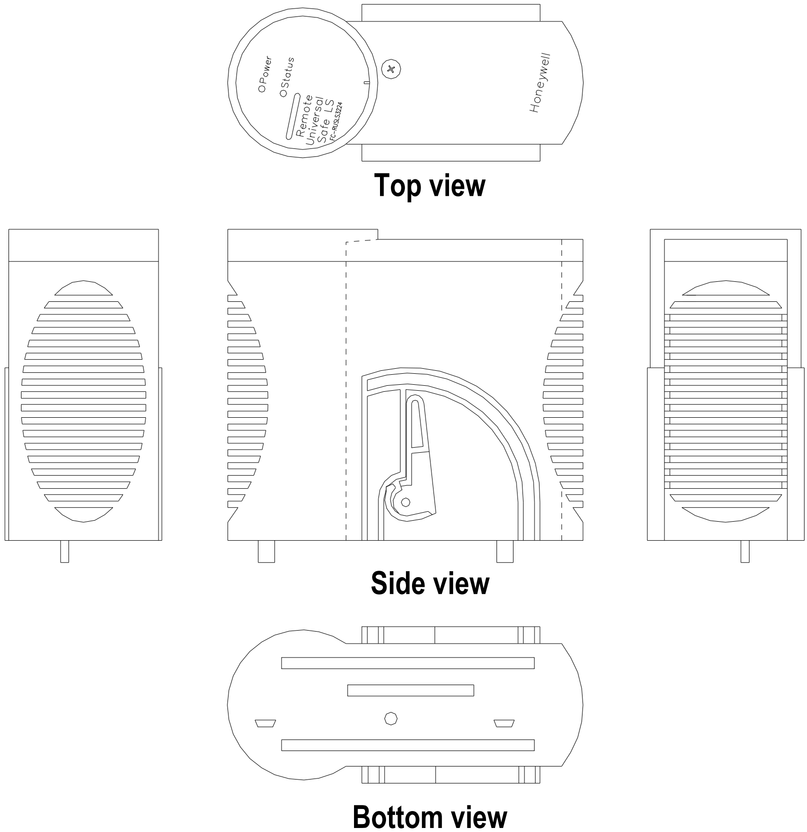
- Digital input (with or without loop monitoring)
- Digital output (with loop monitoring)
- Analog input (0-20mA or 4-20mA active)
- Analog output (0-20mA or 4-20mA active)

The RUSLS-3224 module supports two (100Mbaud) ethernet links to communicate with a SM Controller.

The RUSLS-3224 module has a housing that is in line with the patented Series C design of Honeywell. It needs to be placed on an IO Termination Assembly (IOTA).

Figure 263 on page 440 shows physical appearance of the RUSLS-3224 module.

Figure 263 RUSLS-3224 module - top, side and bottom view



The RUSLS-3224 module has the following features:

- 32 universal IO channels that can be configured to control DI, AI, DO, AO
- any type of IO field signal has only to be connected to the two connections of the applicable universal channel on the IOTA
- proven-in-use redundant processor concept that complies with the SIL 3 safety requirements in single channel operation
- logic solving that enables localized safeguarding of equipment under control (EUC)
- redundant memory for system and application programs
- a dedicated communication link between these processors

- a redundant communication link with the partner module (in redundant configuration)
- an Ethernet-based SM RIO link to the SM Controller in the network via dedicated switches; the SM RIO link uses a dedicated protocol
- monitoring the temperature of the electronics
- a configurable ESD function via channel 32 for dedicated safety related functions
- function-tested watchdogs that: monitor and/or handle:
  - monitor cycle time and supply voltage
  - handle the ESD function and memory errors
- LED indicators at the front of the module for power and health status indication
- real-time clock for Sequence Of Event (SOE) time stamping with a resolution of 1 msec

The RUSLS-3224 module functions as a local Logic Solver and as a universal IO module within the Safety Manager concept. It executes:

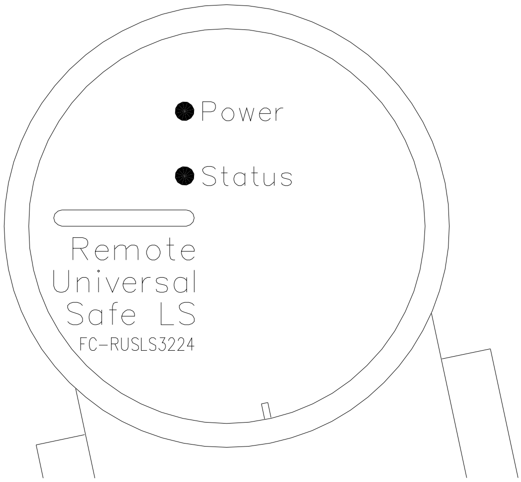
- the input scan of the process variables
- all functional tests of its hardware
- data exchange with its partner module
- the application logics of those FLDs within that are assigned to the module, independently
- data exchange via the SM RIO link with the SM Controller that executes the application logics of those FLDs that are not assigned to the module
- update the outputs and thus the process

The FLASH nature of the memory allows for on line upgrading within the TUV-approved concept of both the system software as well as the channel configurationand [parts of] the application program.

Power and status indications

The RUSLS-3224 module has two LEDs; one for power indication and one for status indication (see Figure 264 on page 442).

Figure 264 RUSLS-3224 module - power and status indications



The table below specifies the applicable indications:

LED indication		Status
Power LED	Green, steady	Power to the module is switched on
	Off	Power to the module is switched off
Status LED	Green, steady	Running without hardware fault
	Red, steady	Running with hardware fault(s)
	Green, flashing, toggle 1 Hz	Idle without hardware fault
	Red, flashing, toggle 1 Hz	Idle with hardware fault(s)
	Red, flashing, toggle 4 Hz	Application / firmware loading
	Off	Module has stopped

Logic solving

The RUSLS-3224 module is capable of logic solving. Logic solving by the module enables localized safeguarding of equipment under control (EUC). This is achieved by the execution of the application logic (FLDs) that is assigned to the module. Configuration of *Remote Universal Safe Logic Solving* is done in Safety Builder; for relevant details see the *Software Reference*.

Localized safeguarding offers distinct benefits. A major advantage is that logic solving by the RUSLS-3224 module is unaffected when:

- communication with Safety Manager is lost,
- Safety Manager experiences a shutdown.

Attention:

A prerequisite for localized safeguarding is that the applicable FLDs only use IOTA resident IO.

Another advantage of localized safeguarding is that it saves execution capacity within the Control Processor of Safety Manager, potentially decreasing its application cycle time.

Execution capacity for localized safeguarding mainly depends on the number of points configured on FLDs that are assigned to the module. Absolute limitations are listed below:

Type	Base	Maximum number
Markers	-	512
Bytes registers	-	256
Counters	-	16
Timers	10 msec	4
	100 msec	32
	1 sec	32
	1 min	16

ESD function

The RUSLS-3224 module has one channel that can be configured as Emergency ShutDown (ESD) input; this is channel 32. To configure channel 32 as ESD input in Safety Builder, the two pins fork on the **CN4** terminals on the IOTA must be in the **ENABLE** position (connecting pins 1 and 2).

Channel 32 must be configured for the ESD function in the software also, in order to execute the proper tests for the ESD channel.

When the (field) switch on the ESD input opens, the universal IO watchdogs switch off and all digital outputs of the connected RUSLS-3224 module(s) will go off and remain off. There is *no* software action required to do this; also there is *no* software action that can prevent this.

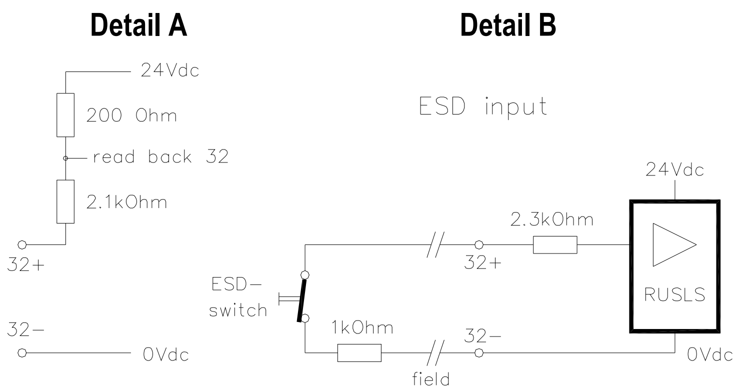
See detail A of Figure 265 on page 444 for a block diagram of this ESD input.

See detail B of Figure 265 on page 444 for the ESD input field connection.

The ESD input is line monitored (for short circuit in the field wires).

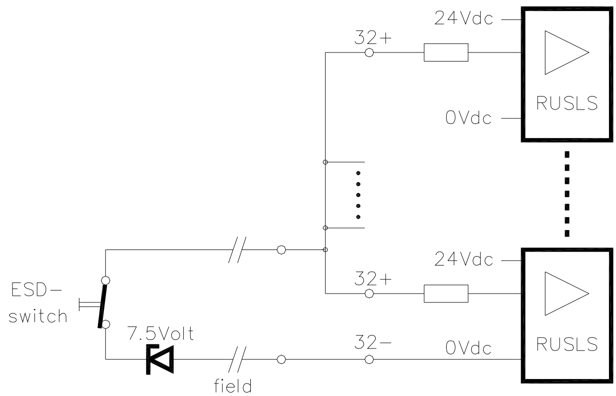
Place the (1kOhm) line termination resistor on (or near) the switch.

Figure 265 ESD input of a universal IO channel



Connecting multiple ESD-inputs of RUSLS-3224 modules with one switch requires a 7.5Volt zener, see Figure 266 on page 445.
All RUSLS-3224 modules involved must be supplied out of the same 24Vdc (power rail).
A 1 Watt zenerdiode - like the 1N4737A or the BZV85-C7V5 - can handle upto 10 ESD inputs of (redundant) RUSLS-3224 modules.
A 5 Watt zenerdiode - like the 1N5343B - can handle upto 50 ESD inputs of (redundant) RUSLS-3224 modules.

Figure 266 ESD switch to multiple universal IO modules



Technical Data for an ESD input

Open voltage:	24 Vdc -20% ... +30%
Closed contact current:	7 mA ± 5% (at 24Vdc)
Switch resistor (single):	1 kOhm ± 5% >0.25W
Switch zener (multiple):	7.5 Volt
Open contact current:	< 4 mA ± 5%
Short circuit detection:	field resistance < 500 Ohm ± 50%
ESD to outputs off delay:	10 ms ± 30%

IO channels

The RUSLS-3224 module has 32 remote universal safe IO channels.

One RUSLS-3224 module can be placed on a non-redundant IOTA to establish 32 non-redundant channels. Two RUSLS-3224 modules can be placed on one redundant IOTA to establish 32 redundant universal safe IO channels.

Each channel has two screw positions for the connection of field wires on the IOTA. No additional connections for field devices are required.

Positions 1+ thru 32+ are the signal connections; one for each of the channels.

Positions 1- thru 32- are (all) directly connected with the 0Volt supply connection.

All channels are 24Vdc sourcing (“active”).

Each channel can be configured as (line monitored) input or output. Some channels have additional configuration features. In the next topics the features and specific technical data of the various configurations are described. The topic titles reflect the function that a channel will have once it is configured.

Line-monitored digital input

The line-monitored input of the RUSLS-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 267 on page 447 for a block diagram of this universal IO channel configuration.

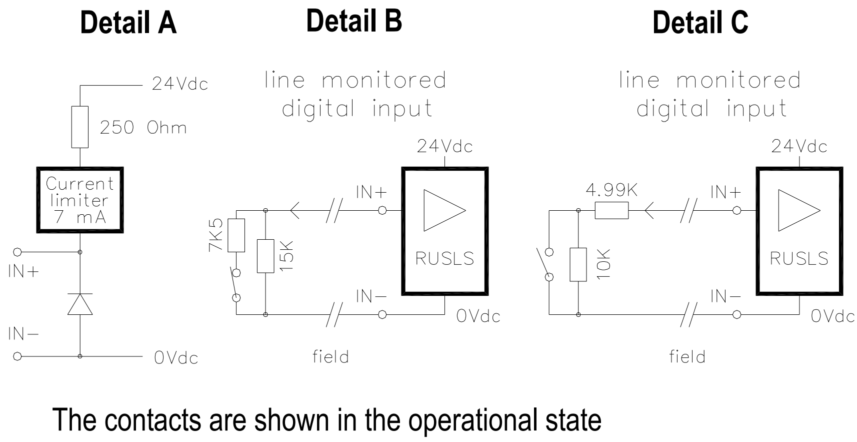
A line-monitored digital input requires two resistors in the field, near the switching element.

For Normally Closed (field-)contacts, these resistors must be connected in parallel, close to the switch. See detail B of Figure 267 on page 447.

For Normally Open (field-)contacts, these resistors must be connected in series, close to the switch. See detail C of Figure 267 on page 447.

Lead-breakage or short circuit in the wires to the switching element will be detected and result in a warning by the RUSLS-3224.

Figure 267 Line-monitored digital input of a universal IO channel



Technical Data for a line-monitored digital input

All channels	Open voltage:	24 Vdc -20% ... +30%
	Short circuit current:	7 mA ± 5%
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Open contact:	15 kOhm ± 5% >0.1W
	Closed contact:	5 kOhm ± 5% >0.25W
	Short circuit detection:	I > 6.3 mA ± 5%
	Closed contact detection:	2.8 mA < I < 6.3 mA ± 5%
	Open contact detection:	0.7 mA < I < 2.1 mA ± 5%
	Lead breakage detection:	I < 0.7 mA ± 5%
	Input filter:	first-order low-pass 100 Hz

Non line-monitored digital input

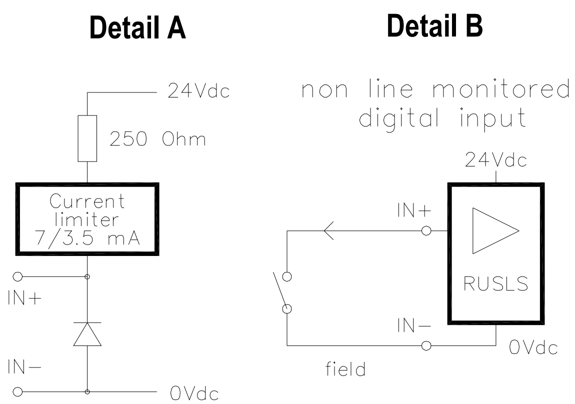
The non line-monitored input of the RUSLS-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 268 on page 448 for a block diagram of this universal IO channel configuration.

A non line-monitored digital input has a switching element in the field; see detail B of Figure 268 on page 448.
This input has no short circuit or lead breakage detection.

Attention:

Channels configured as non line-monitored digital inputs may not be used as part of a safety loop.

Figure 268 Non line-monitored digital input of a universal IO channel



Technical Data for a non line-monitored digital input

All channels	Open voltage:	24 Vdc -20% ... +30%
	Closed contact current:	7 mA ± 5%, after open state detection
		3.5 mA ± 5%, after closed state detection
	Current limiter voltage drop:	< 1.4 Volt (while NOT limiting)
	Closed contact detection:	I > 2.8 mA ± 5%
	Open contact detection:	I < 2.1 mA ± 5%
	Input filter:	first-order low-pass 100 Hz

Analog input 0-20mA and 4-20mA

The analog input of the RUSLS-3224 module consists of a 250 Ohm resistance and an electronic current limiter. See detail A of Figure 269 on page 449 for a block diagram of this universal IO channel configuration.

An analog input is typically connected with a sensor in the field.
That sensor can also be a smoke or fire detector.
See details B and C of Figure 269 on page 449 for examples.

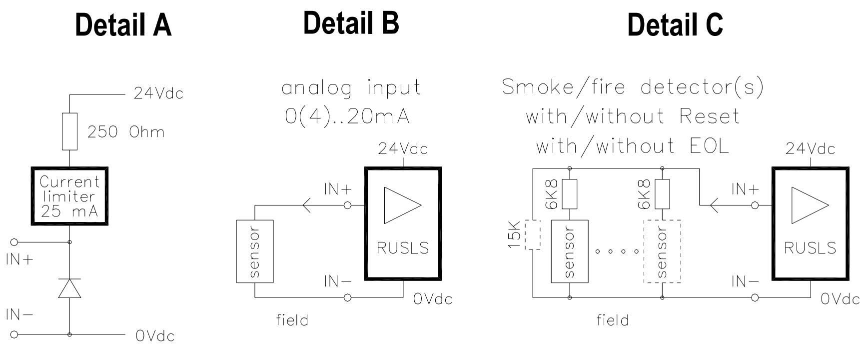
A latching smoke or fire detector can be reset by the RUSLS-3224 module without extra components or wires.
It is possible to connect multiple smoke or fire detectors (up to 6) on one channel.
Line monitoring and sensor state must be handled in the function block.
For a wiring example see detail C of Figure 269 on page 449.

An analog input can be configured for 0-20mA or 4-20mA and is always active (internally sourced out of the 24Vdc supply).

Short circuit in the wires to the sensor will be detected and result in a warning by the RUSLS-3224.

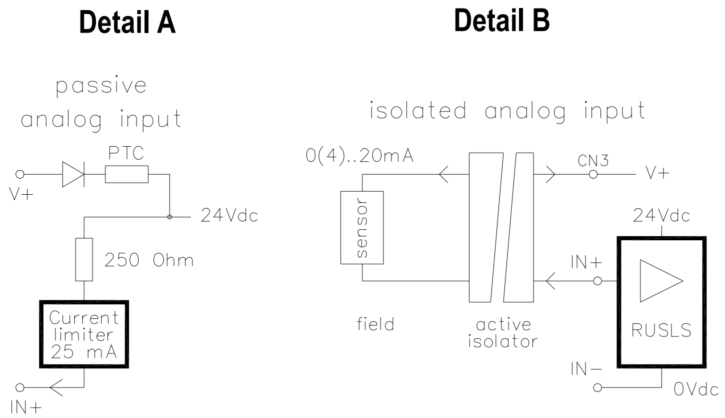
If the input is configured for 4-20mA, than lead breakage of the wires will also be detected and result in a warning by the RUSLS-3224 module.

Figure 269 Analog input of a universal IO channel



A passive analog universal IO input 0-20mA or 4-20mA can only be created if the current source is isolated. See detail A of Figure 270 on page 450 for a block diagram of this universal IO input.
Passive analog universal IO inputs use a V+ pin of **CN3** on the IOTA. See detail B of Figure 270 on page 450 for an example.

Figure 270 Passive analog input of a universal IO channel



Technical Data for an analog input

Open voltage:	24 Vdc -20% ... +30%
Field voltage:	> 15 Vdc (at 0 ... 24 mA)
Short circuit current:	24.5 mA ± 0.5 mA
Input range:	0-20mA or 4-20mA
Input impedance:	typically 250 Ohm
A-D conversion:	16 bit
Accuracy:	0.15% of full scale
Safety-related inaccuracy:	< 1% of full scale
Input filter:	first-order low-pass 100 Hz

Warning:

1. All active field devices shall be galvanically separated (isolated) from live voltages. Live voltages are voltages higher than 30Vac or 40Vdc.
2. Drawing more than 24 mA will cause extra heat dissipation in the housing of the RUSLS-3224 module. For more information refer to “Temperature derating” on page 454.

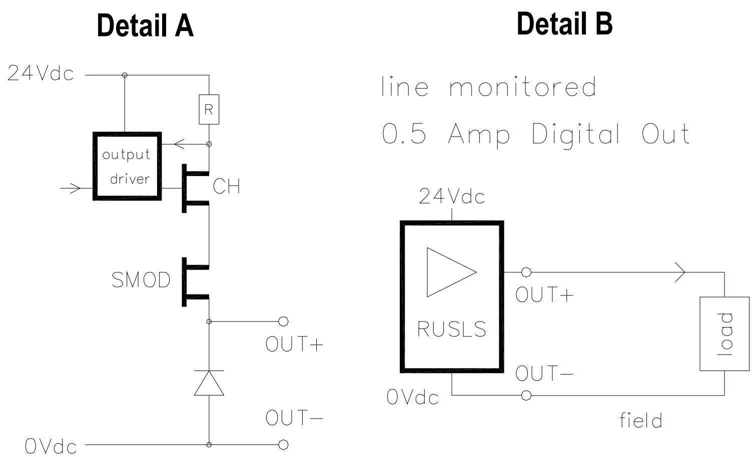
Digital output

The digital output of the RUSLS-3224 module consists of a (0.5 Amp current limited) output with a Secondary Means Of De-energisation (SMOD) FET output.
Each output has a SMOD to enable switching off the channel, even if the channel FET fails. See detail A of Figure 271 on page 451 for an example.

The output driver limits the output (short circuit) current and switches off the output if an overload condition lasts too long.

All digital outputs are off when the universal IO watchdogs are tripped.

Figure 271 (Single) digital output of a universal IO channel



Lead breakage detection in the (field-) wiring is achieved by sourcing a small current (1 mA) into the field. Failure to conduct this current indicates lead breakage.

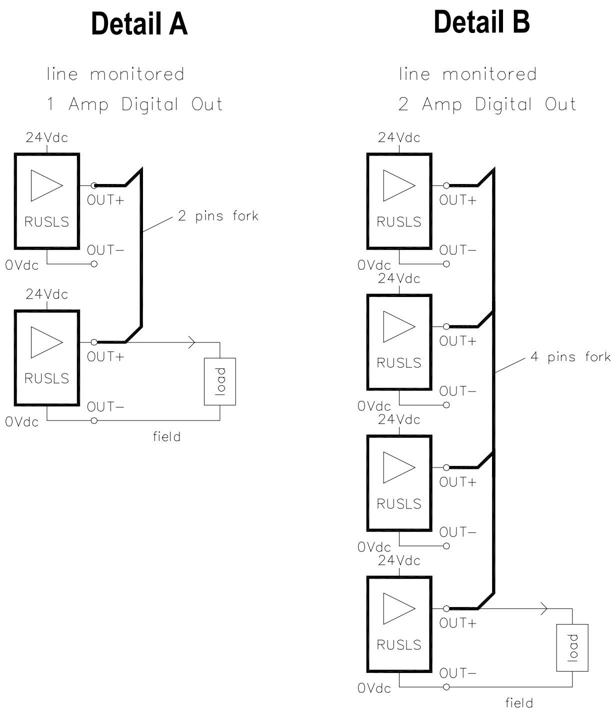
Loads of more than 0.5Amp are supported with the multiple output option.

Sets of two or four outputs can be configured as a multiple output, respectively capable of sourcing up to 1 Amp or 2 Amp.

A 2 pins fork with a pitch of 5.08mm (or a 4 pins fork with a pitch of 5.08mm) can be used to interconnect the multiple outputs. See details A and B of Figure 272 on page 452 for examples.

The field + wire must be connected with one of the OUT+ pins (together with the fork). Any one of the OUT- pins can be used to connect the field return wire.

Figure 272 Multiple digital output connection of a universal IO channel



Technical Data for a digital output

Output:	24 Vdc solid-state source
	short circuit proof
Maximum (resistive) load:	500 mA
	for more details see “General information about output modules” on page 344
Maximum tungsten-lamp load:	125mA (3 W)
Minimum load:	1 mA
Maximum load capacitance:	1 uF
Voltage drop:	< 1.5 V (at 500 mA)
Off current:	< 0.1 mA
Lead breakage test current:	approx. 5 mA
Two pins fork:	Weidmuller, LPA QB 2
Four pins fork:	Weidmuller, LPA QB 4

Analog output 0-20mA and 4-20mA

The analog output of the RUSLS-3224 module consists of a 250 Ohm readback resistor, a current control circuit with output FET (AO) and a SMOD FET. See detail A of Figure 273 on page 453 for a block diagram of this universal IO output.

An analog output is typically connected with an 0-20mA or 4-20mA analog actuator in the field. See detail B of Figure 273 on page 453 for an example.

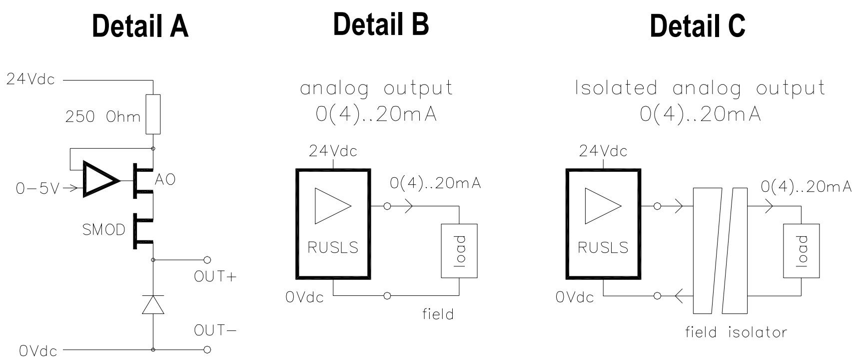
An analog output can be configured for 0-20mA or 4-20mA and is always active. This means that the RUSLS-3224 module provides the required power.

Short circuit in the wires to the load will not be detected.

If the output is configured for 4-20mA, than lead breakage of the wires will be detected and result in a warning by the RUSLS-3224 module.

Isolated analog output signals require an (Ex-)analog isolator module. See detail C of Figure 273 on page 453 for an example of how to connected such an output.

Figure 273 Analog output of a universal IO channel



Technical Data for an analog output

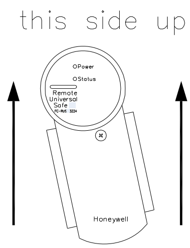
Open voltage:	24 Vdc -20% ... +30%
Output current:	0 - 23 mA
Field (loop) resistance:	max. 500 Ohm
D-A conversion:	12 bit
Accuracy:	0.15% of full scale
Safety-related inaccuracy	< 1% of full scale

Temperature derating

This sub section addresses ‘outside module temperature’. The maximum outside module temperature must be limited depending on the internal dissipation.

Attention:

1. Airflow in / through the module is assumed to be natural convection.
2. Make sure that RUSLS-3224 modules are installed in the correct position. A RUSLS-3224 module must be mounted in upright position (refer to the figure at the right).



To determine the maximum acceptable outside module temperature for a typical configuration do the steps below. Relevant details are given in separate topics.

Outline of the procedure	For details see
1 Perform the Internal dissipation calculation. **a.** Determine which supply voltage applies to your configuration: - 25V or less, - more than 25V or unknown. **b.** Select the applicable reference table. **c.** Determine and record the actual configuration data. **d.** Calculate the totals per dissipation contributor. **e.** Add the totals of the previous step to determine the internal dissipation.	page 455
2 Determine the maximum acceptable outside module temperature. Use the applicable derating curve, based on the supply voltage: • 25V or less: use the derating curve in Figure 274. • more than 25V or unknown: use the derating curve in Figure 275.	 page 457 page 459

Tip:

You can make a print of the applicable calculation table to make annotations of your specific configuration(s). Make sure to fill in the table for the applicable supply voltage.

Internal dissipation calculation

To calculate the maximum outside module temperature, you need the configuration. The maximum dissipation caused by the logic of the RUSLS-3224 module is a fixed value. Other dissipation contributions depend on the channel configuration. The maximum dissipation per channel type depends on the applicable supply voltage.

Select the appropriate table to carry out the calculation, based on the supply voltage:

- 25V or less: 25V (default) - Table 62 on page 455,
- more than 25V or unknown: 31.2V (maximum) - Table 63 on page 456.

Table 62 Dissipation calculation - supply voltage 25V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSLS [1]	0.49		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335		
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Table 63 Dissipation calculation - supply voltage 31.2V

Dissipation contributor (P)	**Max. dissipation per channel [W]**	**Number of configured channels**	**Dissipation [W]**
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01		
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05		
AI; > 24 mA; Current limited by RUSLS [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			
Max. outside module temperature [°C]			

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Good practice for the high dissipating channels is:

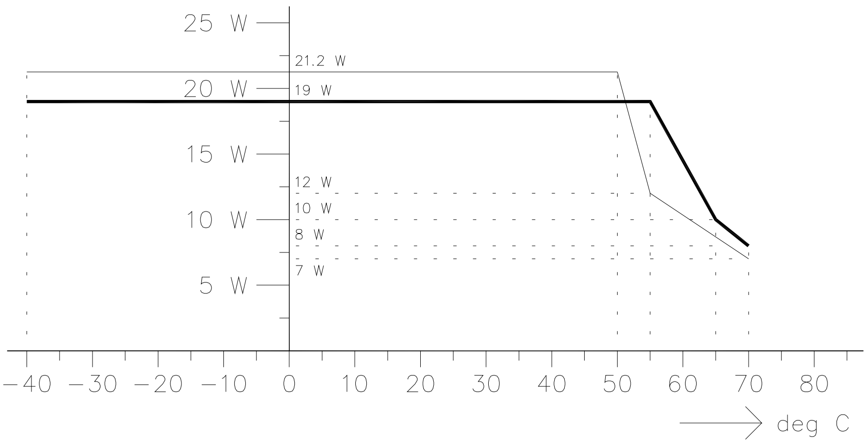
1. To distribute them over the two IO boards in the module between CH1-16 and CH17-32.
2. To select the channels at the bottom of the IO boards (near CH16 and CH32).

Temperature derating curves (25V supply voltage)

Figure 274 shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 25V supply voltage.

An example calculation for this supply voltage is given in Table 64 on page 458.

Figure 274 Module derating with a supply voltage of 25V default



Thick line: applicable for most applications having AO<=20mA and AI<=24mA

Thin line: applicable if one or more channels have AO>20mA or AI>24mA

Table 64 shows a calculation example using the table for a 25 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in Figure 274 on page 457 the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 70°C, with the **High temperature shutdown** of the module set at 90°C.

Note:

The maximum outside temperature limit can be improved with forced airflow.

Table 64 Example: dissipation calculation - supply voltage 25V

Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	10	0.1
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	10	0.5
AI; > 24 mA; Current limited by RUSLS [1]	0.49		
DO; <0.3 A	0.115	10	1.15
DO; <0.5 A	0.305		
AO; 500 Ohm field impedance; < 23 mA	0.225		
AO; 250 Ohm field impedance; < 23 mA	0.335	2	0.67
AO; < 250 Ohm; < 23 mA	0.47		
AO; < 250 Ohm; < 20 mA	0.42		
Total Power Dissipation (TPD) [W]			**7.92**
Max. outside module temperature [°C]			**+ 70**

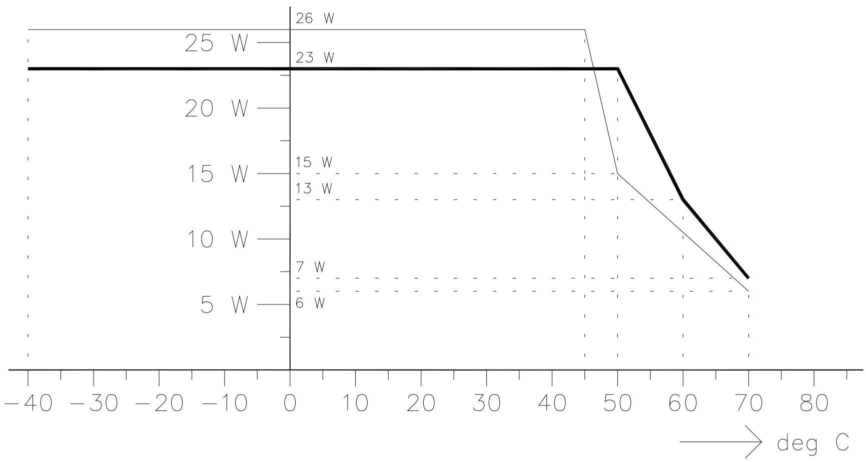
1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Temperature derating curves (31.2V supply voltage)

Figure 275 shows the maximum outside module temperature versus the internal power dissipation. It shows the derating curves for 31.2V supply voltage.

An example calculation for this supply voltage is given in Table 65 on page 460.

Figure 275 Module derating with a supply voltage of 31.2V



Thick line: applicable for most applications having AO<=20mA and AI<=24mA

Thin line: applicable if one or more channels have AO>20mA or AI>24mA

Table 65 shows a calculation example using the table for a 31.2 V supply voltage. The column “Number of configured channels” is filled in for the actual situation. Totals per channel type are calculated in the column “Dissipation contribution”.

The “Total internal power dissipation” is calculated at the bottom. Using the applicable line in Figure 275 on page 459 the maximum outside module temperature is deduced.

In this example the maximum outside module temperature allowed is 65°C, with the **High temperature shutdown** of the module set at 90°C.

Note:

The maximum outside temperature limit can be improved with forced airflow.

Table 65 Example: dissipation calculation - supply voltage 31.2V

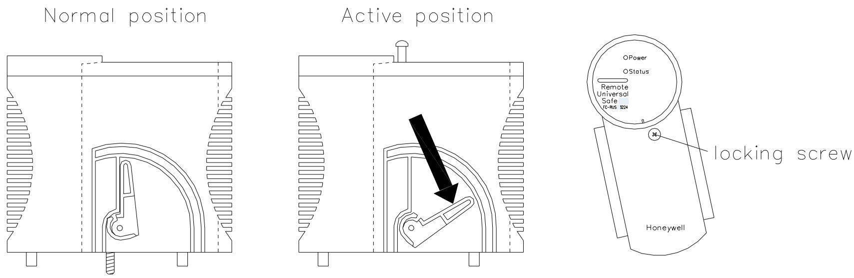
Dissipation contributor (P)	Max. dissipation per channel [W]	Number of configured channels	Dissipation [W]
Logic			5.5
DI-LM; field impedance ≥ 5 KOhm	0.01	2	0.02
DI; closed contact; 3.5 mA	0.085		
AI; < 24 mA; Current limited by field	0.05	21	1.05
AI; > 24 mA; Current limited by RUSLS [1]	0.64		
DO; <0.3 A	0.115		
DO; <0.5 A	0.305	9	2.75
AO; 500 Ohm field impedance; < 23 mA	0.345		
AO; 250 Ohm field impedance; < 23 mA	0.48		
AO; < 250 Ohm; < 23 mA	0.61		
AO; < 250 Ohm; < 20 mA	0.545		
Total Power Dissipation (TPD) [W]			**9.32**
Max. outside module temperature [°C]			**+ 65**

1 Analogue input currents above 24mA should be avoided. Field devices for the analogue input should be configured to drive currents below 24mA, e.g. 3.5mA for sensor fault conditions to minimize the universal IO internal power dissipation. The thin-line derating curve needs to be taken when using currents above 24 mA.

Module handling - replacement

This sub section describes the procedures for removal and installation of a RUSLS-3224 module. See Figure 276 on page 461 for relevant details.

Figure 276 Module handling - removal lever



Removal of a RUSLS-3224 module

Do these steps in the order given to remove the subject RUSLS-3224 module:

1. On the IOTA, set the applicable switch (**POWER 1** or **POWER 2**) to **OFF**. The **Power** LED (green) must go off.
2. Completely loosen the locking screw.
3. Press both (removal) levers at the sides of the module down *at the same time*. See **Active Position** in Figure 276.
4. Remove the module from the IOTA.
5. Put the (removal) levers back in the upright (normal) position.

Installation of a RUSLS-3224 module

Do these steps in the order given to install the subject RUSLS-3224 module:

1. On the IOTA, make sure that the applicable switch (**POWER 1** or **POWER 2**) is set to **OFF**.
2. On the module to be installed, make sure that the (removal) levers are in the upright (normal) position.
3. Hold the module in the correct position on the IOTA and carefully push it down on the corresponding connectors.
4. Tighten the locking screw.
5. On the IOTA, set the applicable switch (**POWER 1** or **POWER 2**) to **ON**. The **Power** LED (green) must go on.

Technical data

The RUSLS-3224 module has the following specifications:

General	Type number:	FC-RUSLS-3224
	Operating temperature:	
	• outside module temperature:	–40°C ... +70°C (–40°F ... +158°F)
	• inside module temperature:	–40°C ... +90°C (–40°F ... +194°F)
	Storage temperature:	–40°C ... +85°C (–40°F ... +185°F)
	Relative humidity:	10 ... 95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV pending
Power	Supply voltage:	24 Vdc -15% ... +30%
	Supply current:	max 300mA (without field load)
IO	Number of channels:	32
	Channel type:	Universal safe (software configurable)
	• Digital in	max. 32 (with or without line-monitoring)
	• ESD in	max. 1 (with line-monitoring)
	• Analog in	max. 32 (with or without line-monitoring)
	• Digital out	max. 32 (with or without line-monitoring) max. combined load: 9 Amp
	• Analog out	max. 16 (with or without open loop detection)
Physical Data	Dimensions (H x W x D):	145 x 165.1 x 72.4 mm 5.7 x 6.5 x 2.85 in
	Weight:	0.66 kg 1.45 lbs

13 Modules for special functions

This chapter describes the modules for special functions that are available for Safety Manager.

The following modules for special functions are described:

Module		See
10310/1/1	Earth Leakage Detector (ELD)	page 465

General info about modules for special functions

A number of modules for special functions are available, in addition to the modules for processors, and the input and output converter modules.

This chapter describes the following modules:

- 10310/1/1: Earth leakage detectors for different voltages

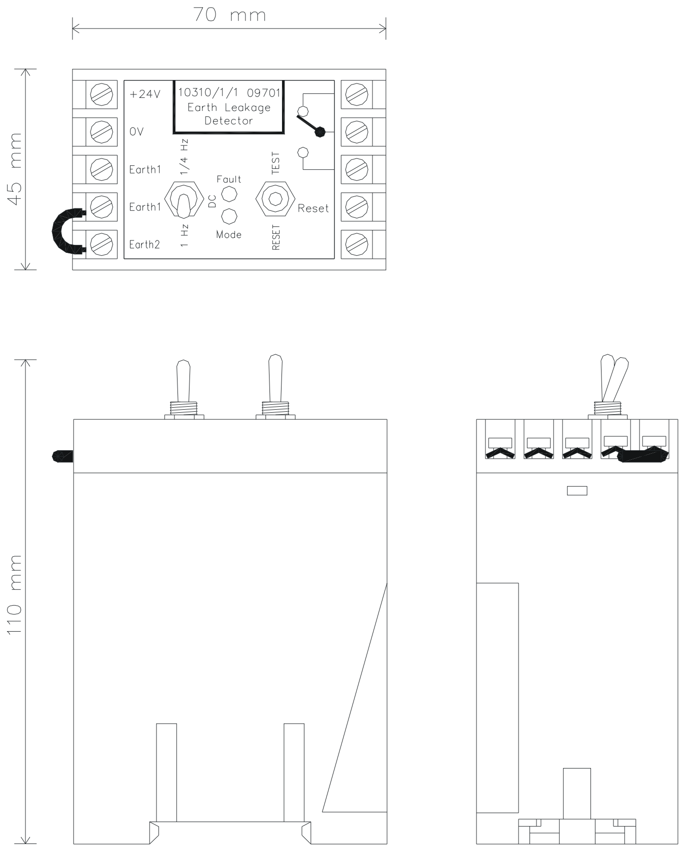
10310/1/1

Earth Leakage Detector (ELD)

Description

The 10310/1/1 module is an Earth Leakage Detector (ELD) for 24 Vdc systems. It has a manually operated self-test feature and an earth connection monitor (switch 2 in **TEST** position).

Figure 277 Module layout



The module has a universal snap-in provision for standard 35 mm DIN EN rails.

The ELD module connects earth level with –12 Vdc (referenced to the 0 V connection of the 24 Vdc supply).

This connection is either:

- Continuous (switch 1 in **DC** position)
- Interrupting at 1 Hz (switch 1 in **1 Hz** position)
- Interrupting at 0.25 Hz (switch 1 in **1/4 Hz** position)

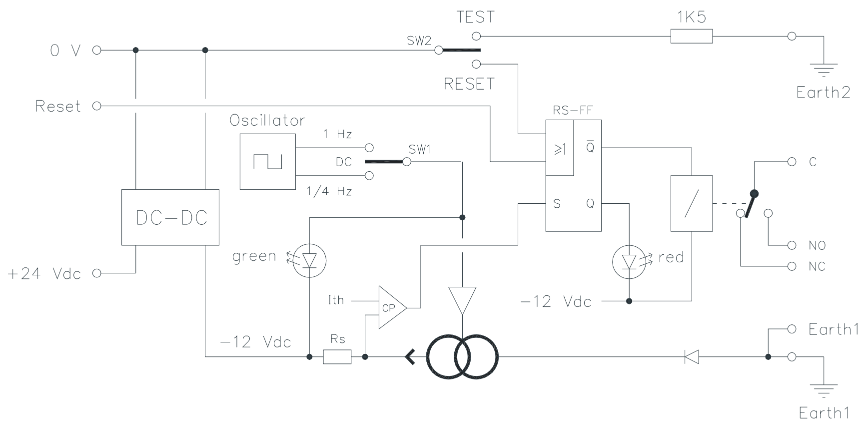
With switch 1 in the **1 Hz** or **1/4 Hz** position, the green "MODE" LED on the module front flashes at the selected connection frequency.

The ELD is normally used with switch 1 in the **DC** position.

The **1 Hz** position should only be used to accommodate solenoids or relays that could stay energized by the negative earth voltage.

The **1/4 Hz** position can be used for locating earth faults. To locate earth faults, you need to use a current clamp (such as the DCM300E digital clamp from AVO International).

Figure 278 Block diagram of 10310/1/1 ELD



An earth fault sets the flip-flop (FF), and de-energizes the relay (see Figure 278 on page 466). The flip-flop remains set until a reset is given.

A reset can be given in two ways:

- Manually (by setting switch 2 to **RESET** position)
- By a high level occurring at the reset input

The ELD module can be tested by connecting a 1.5 kΩ resistor between 0 V and earth. This should set the flip-flop. A 1.5 kΩ resistor in the ELD with its own connection to earth (on the Earth2 pin) allows testing of the ELD and the earth connection (switch 2 in **TEST** position). A disconnected Earth1-to-Earth2 link will block the flip-flop set action (because no earth current is flowing).

By placing a link between Earth 1 and Earth 2, only one earth wire is required. However, a fault in this wire will not be detected during test (see Figure 280 on page 468).

Earth fault for digital inputs

In order to enable detection of an earth fault to an input wire with an open field contact (SDI-1624), you need to ensure the BSDI-16UNI converter module is used. For details, refer to the corresponding data sheet (see section "BSDI-16UNI" on page 337).

Connection examples

The figures below show two connection examples of the 10310/1/1 ELD module. Figure 279 on page 467 shows the preferred wiring because the Earth1 wire is included in the self-test (when switch SW2 is in the TEST position).
Figure 280 on page 468 shows the wiring with a single -non tested- earth connection.

Figure 279 24 Vdc earth fault monitor wiring

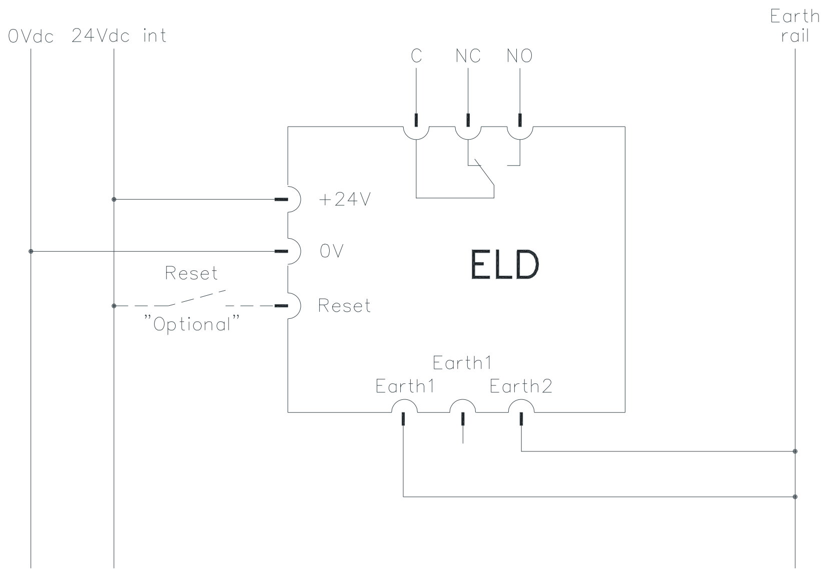
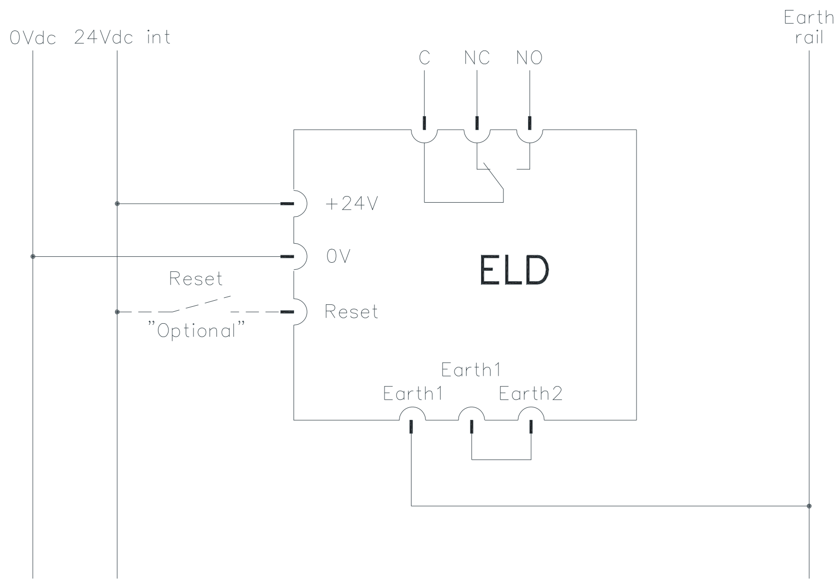


Figure 280 ELD with single earth wire



Technical data

The 10310/1/1 module has the following specifications:

General	Type numbers[1 2]:	10310/1/1 09701 10310/1/1 CC09701
	Operating temperature:	–5°C—+60°C (23°F—+140°F)
	Storage temparature:	–25°C—+80°C (-13°F—+176°F)
	Approvals:	CE, TUV, UL, CSA, FM
Power	Supply voltage:	24 Vdc
	Supply current:	max. 45 mA
	Reset input voltage:	18 — 70 Vdc
	Reset input current:	1.1 mA at 24 Vdc
Earth	Earth voltage:	–12 Vdc (no earth fault) –30 — +70 Vdc (earth fault)
	Earth fault threshold:	5.5 mA (± 1 mA)
	Max. earth current:	25.0 mA (± 5 mA)
	Tightening torque of earth connections:	1 Nm (0.74 ft.-lb.)
Physical	Dimensions (L × W × H):	70 × 45 × 110 mm 2.76 × 1.77 × 4.33 in
	DIN EN rails:	TS35 × 7.5
	Used rail length:	max. 46 mm (1.81 in)
Output contact	Max. output voltage:	36 Vdc / 30 Vac
	Max. output current:	2 A
	Isolation	1500 Vdc / 1000 Vac
	Initial contact resistance:	30 mΩ
	Expected life:	
	• electrical	100,000 switch operations
	• mechanical	200,000,000 switch operations

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 The earlier modules with suffix code 09700 require a power supply current of 60mA. There are no functional changes.

IO Busses

14

This chapter describes the following items:

General info about IO busses

This sub-section contains these topics:

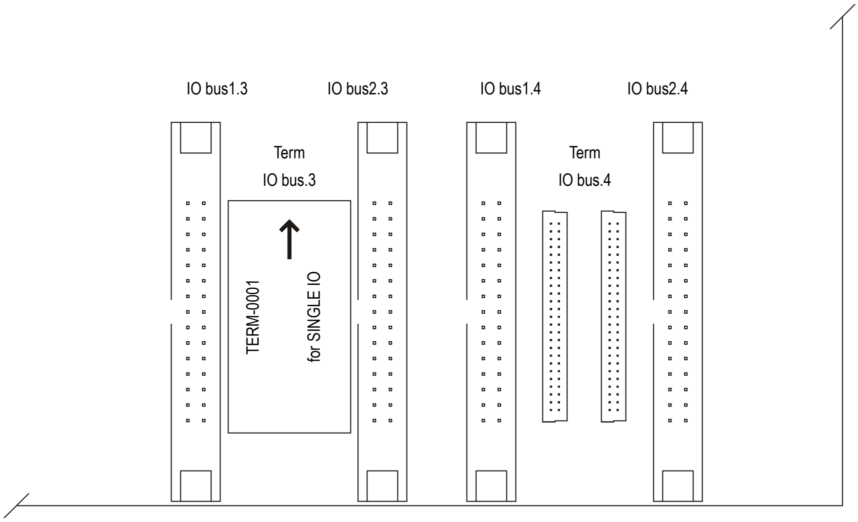
- General info about IO busses (Safety Manager); see page 473,
- General info about IO busses (Safety Manager A.R.T.); see page 476.

General info about IO busses (Safety Manager)

The IO busses in Safety Manager provide a parallel communication link between the Control Processors in the Controller chassis and the IO extender in the IO chassis.

Safety Manager has four (pairs of) IO busses. Figure 281 on page 473 shows a detail of the Controller backplane with two of the four IO bus connector sets.

Figure 281 IO bus connectors detail of the CPB-0001



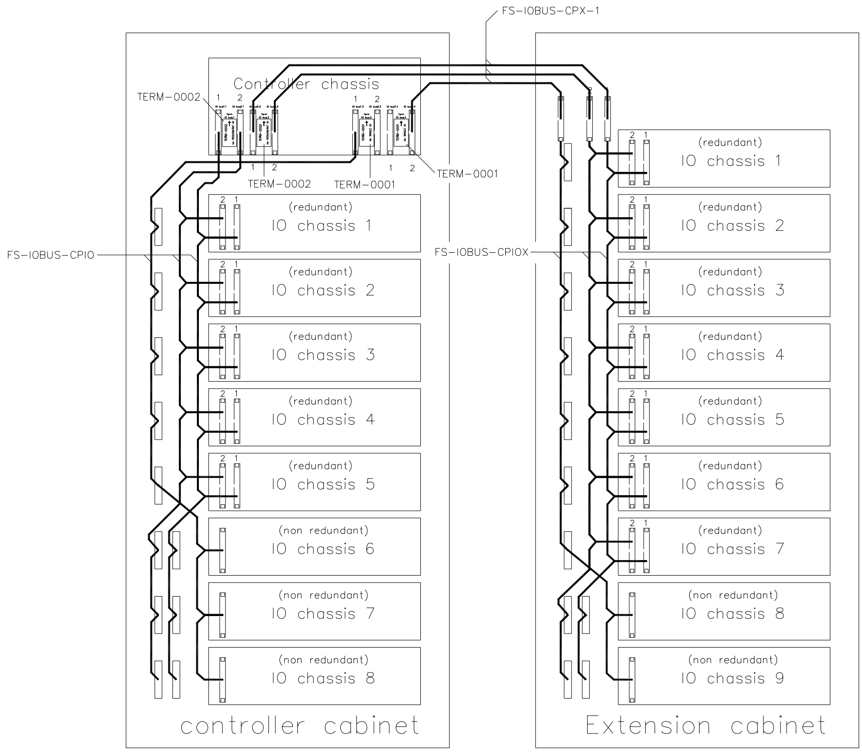
An IO bus connector set consists of two IO bus (flatcable) connectors (IO bus1.x and IO bus2.x) and two connectors for one IO bus terminator board (term IO bus.x).
IO bus.3 in Figure 281 on page 473 has a terminator while IO bus.4 is unused.

Non-redundant IO requires one IO bus (controlled by Control Processor 1 and 2). Redundant IO requires a pair of IO busses (one controlled by Control Processor 1, the other by Control Processor 2).
A specific bus has to be used for non-redundant IO or redundant IO exclusively. Therefore, in Safety Manager with both redundant and non-redundant IO, at least three busses must be used: one pair that is connected to all IO chassis for redundant IO, and one bus that is connected to all IO chassis for non-redundant IO.

Figure 282 on page 474 shows an example of the IO busses in a system with two cabinets:

- Chassis 1 to 5 of the controller cabinet are redundant and connected to IO bus 1.1 resp. IO bus 2.1 of CP1 resp. CP2.
- Chassis 1 to 7 of the extension cabinet are redundant and connected to IO bus 1.2 resp. IO bus 2.2 of CP1 resp. CP2.
- Chassis 6 to 8 of the controller cabinet are non-redundant and connected to IO bus x.3 of CP1 and CP2.
- Chassis 8 and 9 of the extension cabinet are non-redundant and connected to IO bus x.4 of CP1 and CP2.

Figure 282 IO busses example for a two cabinet system



The connection cable between the Controller chassis and the IO chassis is the flatcable assembly IOBUS-CPIO (see section “IOBUS-CPIO” on page 491).

At the Controller chassis side, the IOBUS-CPIO cable is connected to the Controller backplane (see section “Controller backplane CPB-0001” on page 91), and IO bus terminators are placed on all IO busses that are in use.

Non-redundant IO chassis require one cable and a TERM-0001, and redundant IO chassis require two cables and a TERM-0002 (see “TERM-0001 and TERM-0002” on page 485).

At the IO chassis side, the IOBUS-CPIO cable is connected to the backplane of the IO chassis.

A non-redundant IO chassis has one IOBUS-CPIO cable connector marked “IO bus” (see Figure 50 on page 101).

A redundant IO chassis has two IOBUS-CPIO cable connectors marked “IO bus1” and “IO bus2” (see Figure 57 on page 110).

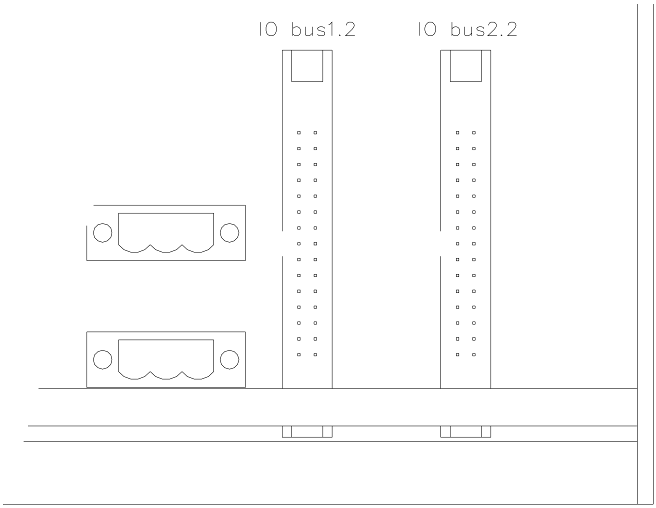
It is important to place the cables in the proper location: The cable on IO bus1.x of the Controller chassis must be placed on the IO bus1 connector of the IO chassis. The cable on IO bus2.x of the Controller chassis must be placed on the IO bus2 connector of the IO chassis.

General info about IO busses (Safety Manager A.R.T.)

The IO busses in Safety Manager A.R.T. provide a redundant set of parallel communication links between the Control Processors in the Controller chassis and the IO extenders in the IO chassis.

Safety Manager A.R.T. has two pair of IO busses. Figure 283 on page 476 shows a detail of the A.R.T. Controller backplane with one pair of IO bus connectors.

Figure 283 IO bus connectors detail of the CPB-0002



An IO bus set for IO chassis in the Controller cabinet consists of two flatcables type IOBUS-CPIO (see “IOBUS-CPIO” on page 491).

An IO bus can control redundant *or* non-redundant IO chassis. The IO busses of a Safety Manager A.R.T. Controller chassis can only control Safety Manager A.R.T. IO chassis.

Figure 284 on page 477 shows an example of a Controller cabinet with both redundant and non-redundant IO chassis.

- IO bus1.x on the CP backplane must be connected to IO bus1 on the IO backplane.
- IO bus2.x on the CP backplane must be connected to IO bus2 on the IO backplane.

Figure 284 IO busses example for a IO chassis in the Controller cabinet

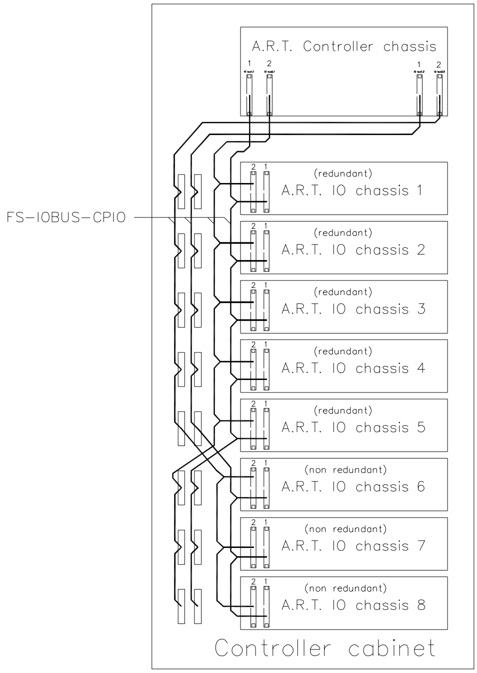


Figure 285 on page 478 shows an example of a Controller cabinet with an extension cabinet.

Table 66 on page 478 shows the possible configurations.

;

Table 66 Possible configurations of a Controller cabinet with an extension cabinet [1]

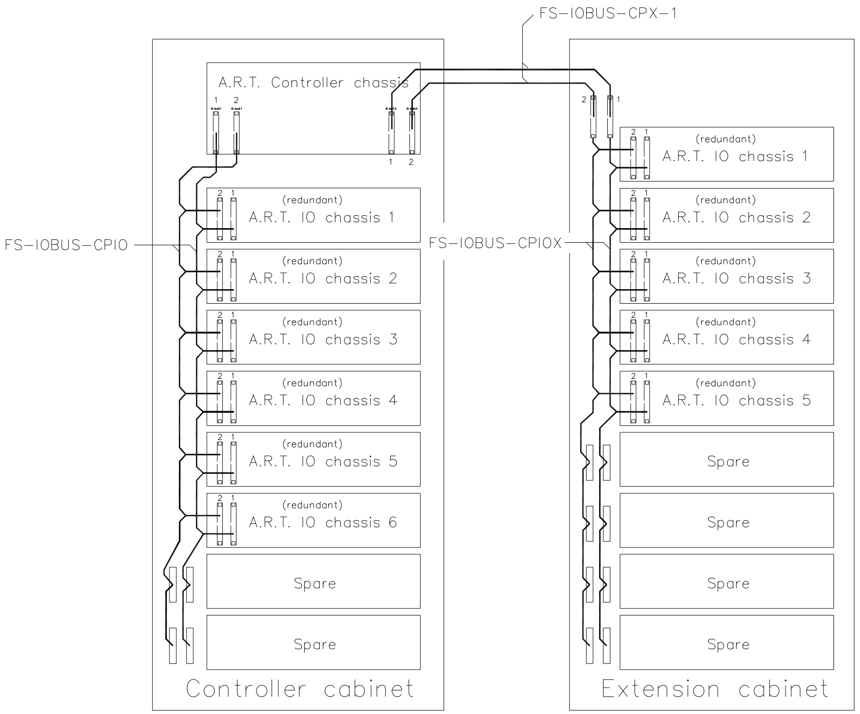
Type of cabinet	Possible configurations						
Controller	R and NR	R	NR	R	R	NR	NR
Extension	-	-	-	R	NR	R	NR

1 R = redundant IO chassis; NR = non-redundant IO chassis

An IO bus set for IO chassis in extension cabinets contains two pairs of flatcables:

- One pair of (round) flatcables type FS-IOBUS-CPX-1, (see “IOBUS-CPX-x” on page 497)
- One pair of flatcables type FS-IOBUS-CPIOX, (see “IOBUS-CPIOX” on page 494).

Figure 285 IO busses example for a IO chassis in the extension cabinet



IO-0001

IO Extender Module (Safety Manager)

Description

The IO extender module is a basic module that is installed in the IO chassis.
The IO extender module transfers the communication of the Control Processor to the IO modules.

- Non-redundant IO chassis (IOCHAS-0001S) have one IO-0001 module, located in slot 21 (see Figure 48 on page 99).
- Redundant IO chassis (IOCHAS-0001R) have two IO-0001 modules, located in slot 20 and 21 (see Figure 55 on page 108).

Note

The IO extender can be replaced when the power is switched on. However, in that case Safety Manager will shut down if the IO Extender is safety-related.

Figure 286 Side view of the IO-0001 module with a flatcable from a non-redundant IO chassis

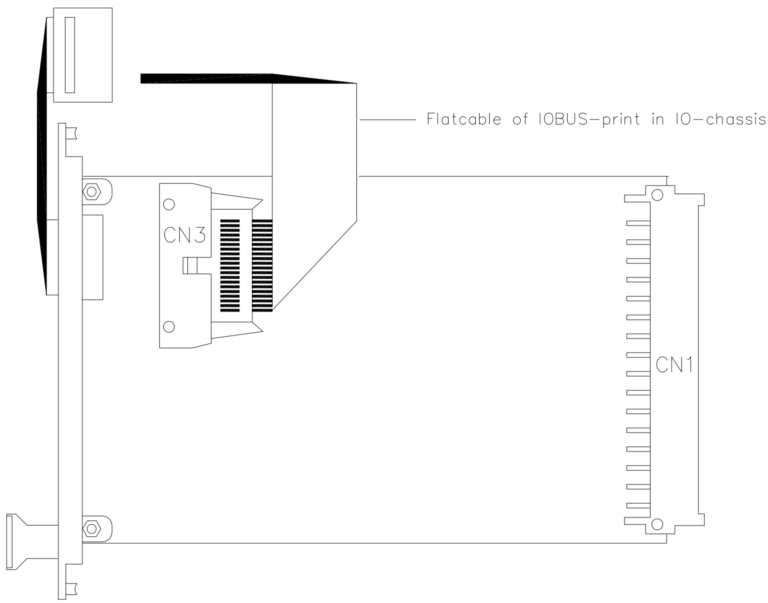
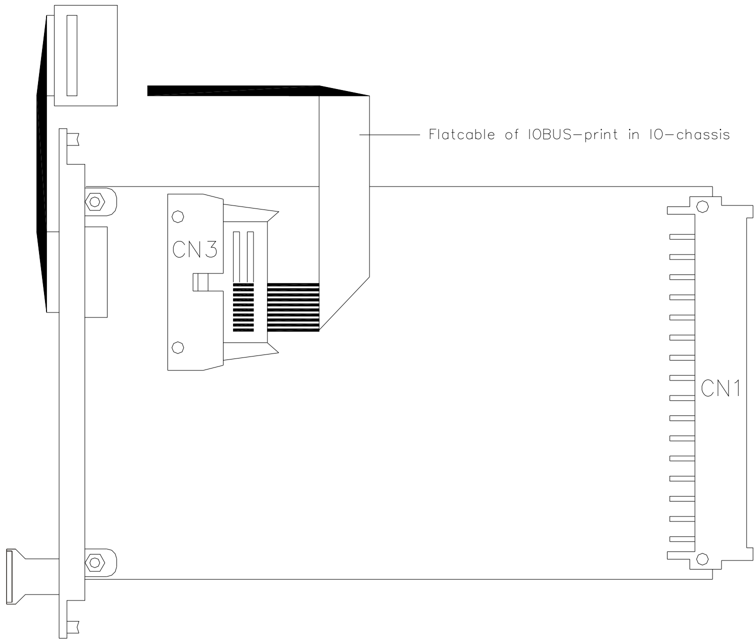


Figure 287 Side view of the IO-0001 module with a flatcable from a redundant IO chassis



The IO extender module communicates with the Control Processor via CN1 (see Figure 286 on page 479).

The flatcable extending from the front of the IO extender module connects the IO extender module to the horizontal IO bus (see Figure 48 on page 99 and Figure 55 on page 108).

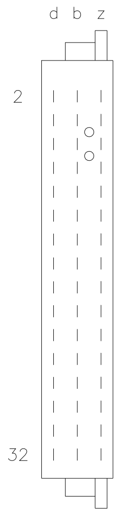
The flatcable assembly with the address selection lines of the IO modules is connected to the IO extender module on connector CN3 (see Figure 286 on page 479 and Figure 287 on page 480).

Pin allocation

The IO extender is fitted with a male chassis connector according to DIN 41612 type F, with the ‘d’, ‘b’ and ‘z’ rows used.

Figure 288 on page 481 shows the back view of the IO-0001 chassis connector:

Figure 288 Back view of IO-0001 connector



Address settings

The chassis address of the IO extender is defined by means of jumpers (CA0, CA1, CA2, CA3) on the IO backplane (see Figure 289 on page 482 for non-redundant IO and Figure 290 on page 483 for redundant IO).

Table 67 on page 482 shows the jumper settings for the possible chassis addresses.

Table 67 Address setting for the IO-0001

Chassis address	Jumper setting[1]			
	CA3	CA2	CA1	CA0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	1	0	0	0
8	1	0	0	1
9	1	0	1	0

1 **0** and **1** positions are marked on the IO backplane
0 = GND 5 Vdc
1 = supply 5 Vdc

Figure 289 on page 482 shows the jumper locations on the non-redundant IO-backplane (shows chassis address 1 selected).

Figure 289 Jumpers on the CPB-0001S

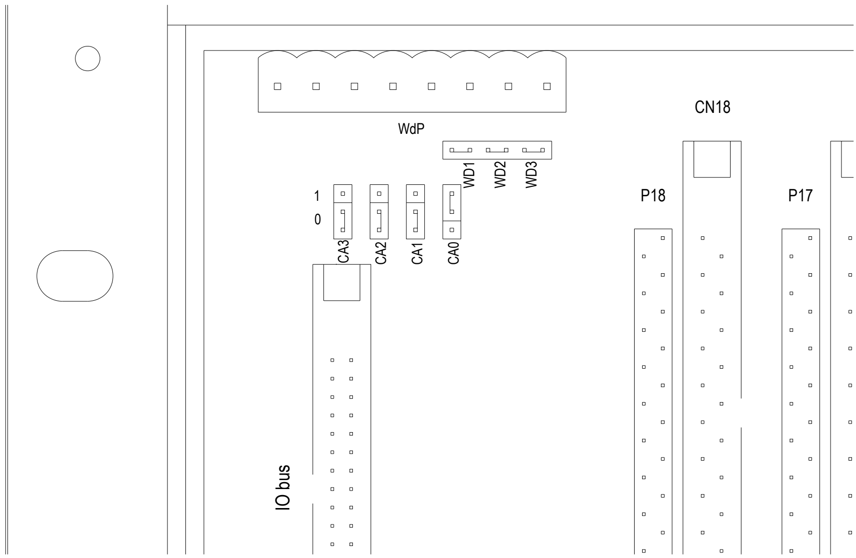
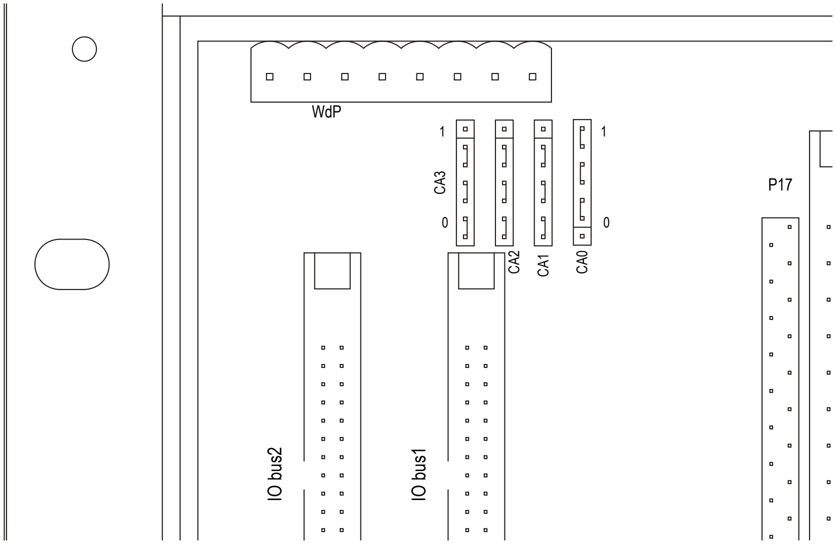


Figure 290 on page 483 shows the jumper locations on the redundant IO-backplane (shows chassis address 1 selected).

Figure 290 Jumpers on the CPB-0001R



Technical data

The IO-0001 module has the following specifications:

General	Type numbers[1] :	FS-IO-0001 V1.0
		FC-IO-0001 CCV1.0
	Approvals:	CE, TUV, UL, CSA, FM
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Power	Power requirements:	5 Vdc, 35 mA
	Ripple content:	< 50 mV p-p
Key coding	(See section “Key coding” on page 17)	
	Module connector code:	
	• Holes	A5, A7
	Chassis connector code:	
	• Large pins	A5, A7

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TERM-0001 and TERM-0002

Bus terminator for non-redundant IO (TERM-0001) and redundant IO (TERM-0002)

Description

The TERM-0001 is a bus terminator for an IOBUS-CPIO flatcable to non-redundant IO. It has 27 termination resistors (1kΩ) and links the IO bus1.x with the IO bus2.x.

The TERM-0002 is a bus terminator for two IOBUS-CPIO flatcables to redundant IO. It has 54 termination resistors (1kΩ) and keeps the IO bus1.x and the IO bus2.x separated.

The TERM-000x terminates all used IO bus signals and is placed on connectors on the Controller backplane (CPB-0001). These connectors are labelled Term IO bus1, Term IO bus2, Term IO bus3 and Term IO bus4.
The presence of a bus terminator on the CP backplane is checked by the software and required for all used IO busses.

Figure 291 on page 485 shows the terminator.

Figure 292 on page 486 shows a detail of the CP-backplane with an TERM-0002 placed.

Figure 291 Front and back view of the TERM-0001

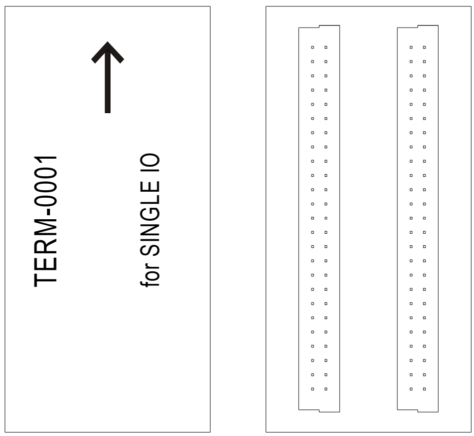
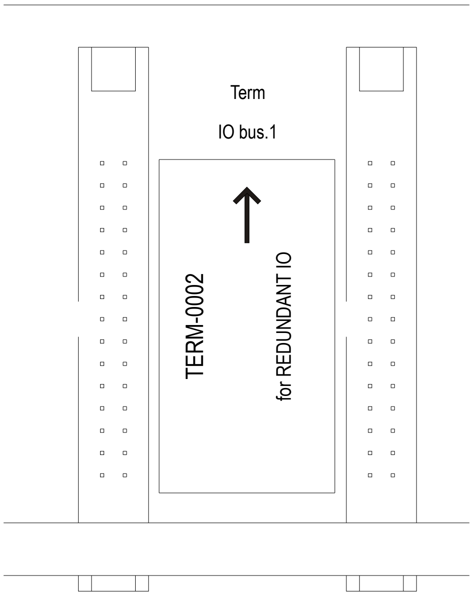


Figure 292 CP backplane detail with an TERM-0002 placed



Choosing the correct terminator

Table 68 on page 486 describes which terminator to use for which configuration.

Table 68 Correct terminator placement for various configurations

Controller	IO	Terminator
Non-redundant	Non-redundant	TERM-0001
Redundant	Non-redundant	TERM-0001
Redundant	Redundant	TERM-0002

Technical data

General	Type numbers[1] :	FS-TERM-0001 for non-redundant IO FS-TERM-0002 for redundant IO
		FC-TERM-0001 for non-redundant IO FC-TERM-0002 for redundant IO
	Approvals:	CE, TUV, UL, CSA, FM
Power	Power requirements:	50 mA (from 5 Vdc of Control Processor)
Physical	Module dimensions:	19.7 × 38.1 × 7.8 mm (0.78 × 1.5 × 0.3 in)
	Weight:	Approximately 4.5 g (0.16 oz)
	Connectors:	2 × SMC female connector, 50-pins

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

IO-0002

IO Extender Module (Safety Manager A.R.T.)

Description

The IO extender module is a basic module that is installed in the IO chassis at positions 20 and 21.
The IO extender module transfers the communication of the Control Processor to the IO modules.

The IO extender module transfers:

- the WatchDog signals of the Control Processors to each IO module position in the IO-chassis.
  This makes it possible to isolate each individual output module in case of an error on that output module (the Watchdog signal of that IO-module is switched off).
- the 5V of the Control Processor chassis to the IO-modules in the IO chassis. This is done in two groups.
  In case of a short (or an overload) in a group, the 5V to that group is switched off while the rest of the system continues to control the process.

In redundant IO chassis:

- 5V group 1 supplies the IO chassis positions 1, 3, 5, 7, 9, 11, 13, 15 and 17
- 5V group 2 supplies the IO chassis positions 2, 4, 6, 8, 10, 12, 14, 16 and 18.

In non-redundant IO chassis:

- 5V group 1 supplies the IO chassis positions 1 thru 9
- 5V group 2 supplies the IO chassis positions 10 thru 18.

The IO extender has a status LED (OFF, GREEN or RED) that indicates the module status.

Each Safety Manager A.R.T. IO chassis has two IO extender modules:

- The IO extender module at position 20 is connected to IO bus1.
- The IO extender module at position 21 is connected to IO bus2.

Note

An IO extender module can be replaced when the power is switched on and the system is controlling the process, provided the other IO extender module in the IO chassis is running without fault.

Address settings

The chassis address of the IO extender is defined by means of jumpers (CA0, CA1, CA2, CA3) on the IO backplane.

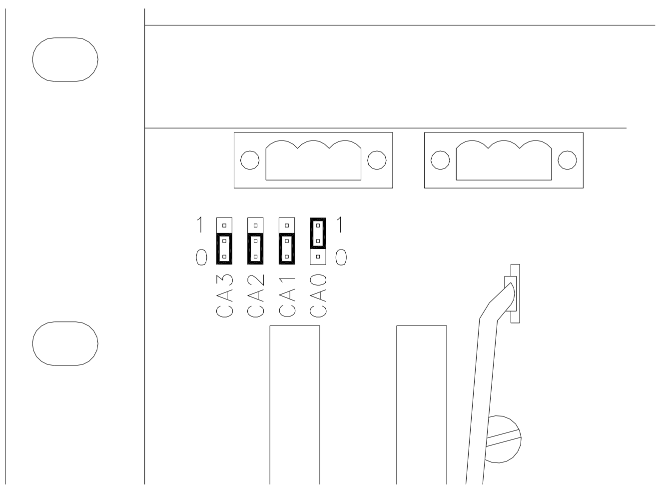
Table 69 on page 489 shows the jumper settings for the possible chassis addresses. Figure 293 on page 489 shows the jumper locations on the IO-backplane (with chassis address 1 selected).

Table 69 Address settings for the IO-0002

Chassis address	**Jumper setting**[1]			
	CA3	**CA2**	**CA1**	**CA0**
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	1	0	0	0
8	1	0	0	1
9	1	0	1	0

1 **0** and **1** positions are marked on the IO backplane
0 = GND 5 Vdc
1 = not connected

Figure 293 Adress jumpers on the IO backplane



Technical data

The IO-0002 module has the following specifications:

General	Type numbers[1]:	FC-IO-0002
	Approvals:	CE; TUV, UL, CSA pending
	Space requirements:	4 TE, 3 HE (= 4 HP, 3U)
Watchdog	Number of inputs: • current:	2 max. 10 mA (WD1in + WD2in)
	Number of outputs: • current:	18 max. 25 mA
Power	Number of inputs: • power requirements: • current:	2 (diode OR-ed) 5Vdc 100 mA + 5V_load of all (18) IO boards + WD_load of all (18) IO boards
	Number of outputs: • voltage drop: • current:	2 groups 0.2V < V < 0.8V (versus highest Vin) > 1.25 Amp (per group)

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

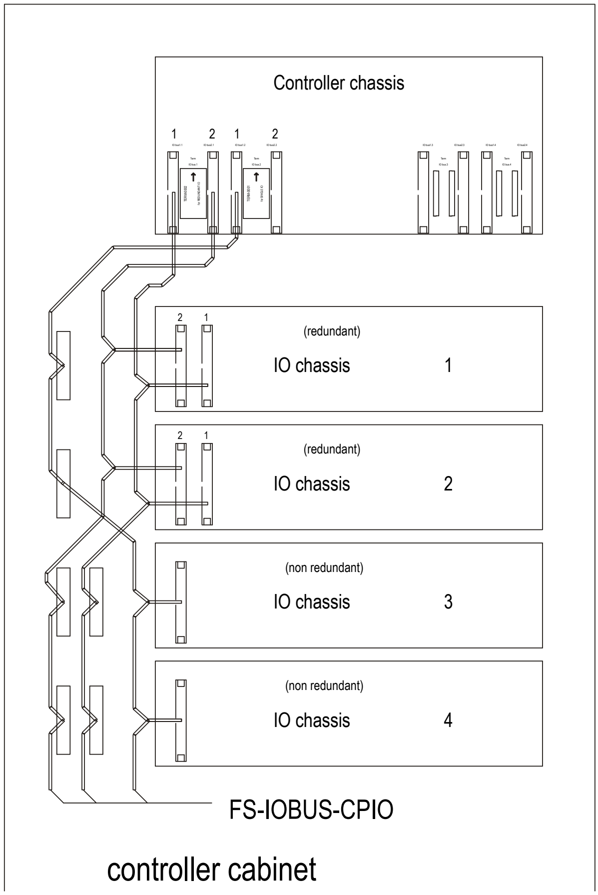
IOBUS-CPIO

IO Bus from Controller chassis to IO chassis

Description

The IOBUS-CPIO is a vertical IO bus (34-wire flatcable) from the Controller chassis (CPCHAS-0001) to one or more IO chassis (IOCHAS-0001S/R), as shown in Figure 294 on page 491. All scan, test and update actions between the QPP module and IO modules are routed via these IO busses.

Figure 294 IOBUS-CPIO busses in a controller cabinet



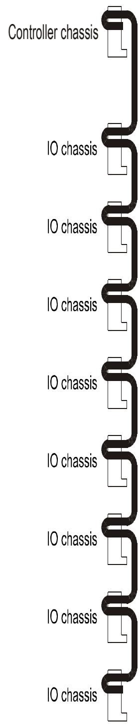
At the side of the Controller chassis, the IOBUS-CPIO is connected to the Controller backplane, to the connector marked **IO busx.x** (see Table 7 on page 94 and Figure 45 on page 88).

At the side of the IO chassis, the IOBUS-CPIO is connected to the IO backplane IOB-0001S/R, to the connector marked **IO busx** (see Figure 50 on page 101 and Table 10 on page 101 or Figure 57 on page 110 and Table 14 on page 110).

The IOBUS-CPIO is used for redundant as well as non-redundant (Controller and/or IO) configurations.

Figure 295 on page 492 shows a side view of the IO bus.

Figure 295 IOBUS-CPIO side view



Technical data

General	Type number:	FS-IOBUS-CPIO
	Approvals:	UL, CSA
Physical	Connectors:	34 pole latch (female)
	Weight:	0,31 kg

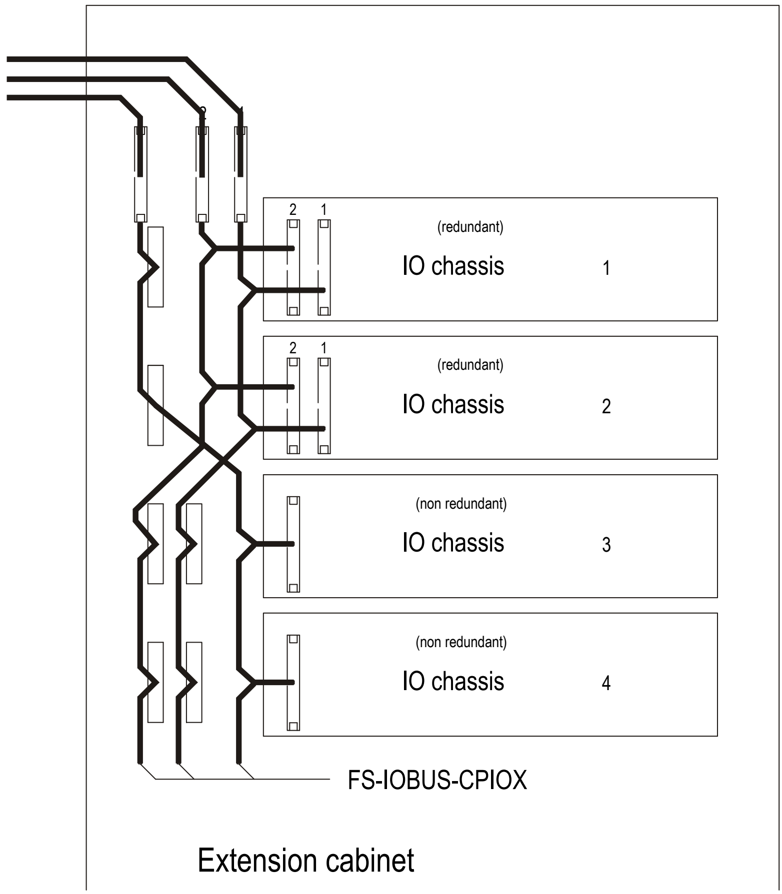
IOBUS-CPIOX

IO bus in extension cabinet

Description

The IOBUS-CPIOX is a vertical IO bus (34-wire flatcable) from the top of an extension cabinet to one or more IO chassis (IOCHAS-0001S or IOCHAS-0001R) in the extension cabinet (see Figure 296 on page 494).
All scan, test and update actions between the QPP-0001 module and IO modules are routed via these IO busses.

Figure 296 IOBUS-CPIOX busses in an extension cabinet



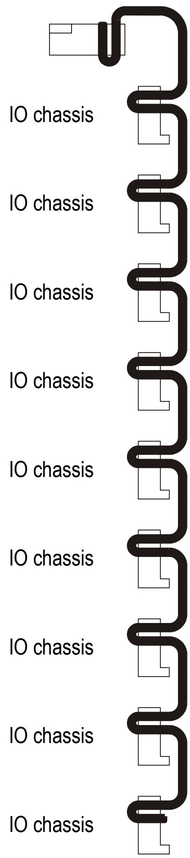
In the top of the extension cabinet, the IOBUS_CPIOX (male connector) is connected with an IOBUS-CPX-x cable (see “IOBUS-CPX-x” on page 497).

The other connectors (female) go to connectors on IO backplanes IOB-0001R marked IO busx (in redundant IO chassis) or on IO backplanes IOB-0001S marked IO bus (in non-redundant IO chassis).

The IOBUS-CPIOX is used for redundant as well as non-redundant configurations.

Figure 297 on page 495 shows a side view of the IOBUS-CPIOX.

Figure 297 side view of the IOBUS-CPIOX



Technical data

General	Type number:	FS-IOBUS-CPIOX
	Approvals:	UL, CSA
Physical	Connector (top):	34 pole latch (male)
	Connectors (other):	34 pole latch (female)

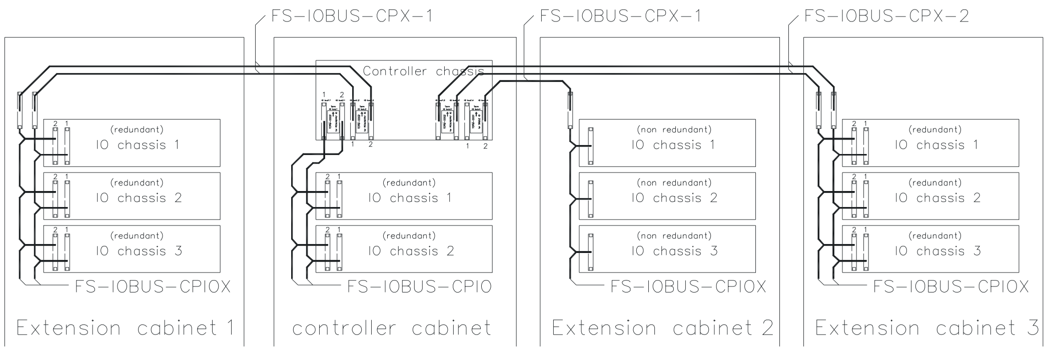
IOBUS-CPX-x

IO bus from controller cabinet to extension cabinet

Description

The IOBUS-CPX-x is an IO bus (34-wire flatcable in a round cable) from the Controller backplane (CPB-0001) to an IOBUS-CPIOX in the top of an extension cabinet (see Figure 298 on page 497).
All scan, test and update actions between the QPP-0001 module and IO modules are routed via these IO busses.

Figure 298 IO busses example with four cabinets

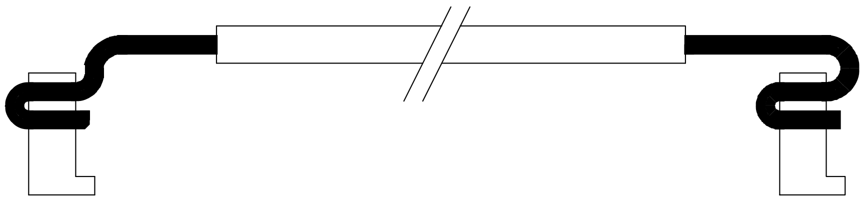


The IOBUS-CPX-x is used for redundant as well as non-redundant configurations.

- The IOBUS-CPX-1 is used between a controller cabinet and an extension cabinet next to the controller cabinet.
- The IOBUS-CPX-2 is used between a controller cabinet and an extension cabinet next to another extension cabinet.

Figure 299 on page 498 shows a side view of the IOBUS-CPX-x.

Figure 299 IOBUS-CPX-x side view



Technical data

General	Type number:	FS-IOBUS-CPX-1 (length 3.4 m) FS-IOBUS-CPX-2 (length 4.2 m)
	Approvals:	UL, CSA
Physical	Length:	3.4 resp. 4.2 m
	Connectors:	34 pole latch (female)

Field Termination Assembly modules

15

This chapter describes the field termination assembly modules that are available for Safety Manager.

The following Field Termination Assembly (FTA) modules are described:

FTA *(continued)*		**see**
TDOL-0724P	Line-monitored relay contact digital output (7 channels, 24Vdc)	page 593
TDOL-0724U	Line-monitored relay contact digital output (7 channels, 24Vdc, RUSIO)	page 604
TDOL-07120	Line-monitored relay contact digital output (7 channels, 120Vac/120Vdc)	page 615
TSDO-0424	Safe digital output FTA (24 Vdc, 4 channels)	page 627
TSDO-04UNI	Safe digital output FTA (24/48/110 Vdc, 4 channels)	page 630
TSDOL-0424C	Conformal-coated safe digital output FTA, current limited, loop monitored (24 Vdc, 4 channels)	page 633
TDO-1624	Non-safe digital output FTA (24 Vdc, 16 channels)	page 638
TSRO-0824	Safe dry digital output FTA for SIL3 applications (8 channels)	page 641
TRO-0824	Non-safe dry digital output FTA (8 channels, NO/NC)	page 651
TRO-1024	Non-safe dry digital output (relay contact) FTA (10 channels)	page 656
TSAO-0220m	Safe analog output FTA (0(4)-20 mA, 2 channels)	page 659
TSAOH-0220m	Safe analog output FTA with HART interface (0-20mA, 2 channels)	page 662
Special FTAs		
TPSU-2430	24 Vdc to 30 Vdc / 1 A converter	page 667
TSPKUNI-1624	Sub-D to Powered Knife terminals FTA (Universal,16ch)	page 671
DCOM-232/485	RS232/485 communication FTA	page 675
SDW-550 EC	5 port HSE communication FTA or "switch"	page 681
MTL 24571	Single channel ethernet surge protector	page 687
Remote IO termination assemblies		
IOTA-R24	Redundant IO Termination Assembly	page 690
IOTA-NR24	Non-redundant IO Termination Assembly	page 700

General info about Termination Assembly modules

Termination assembly modules are divided in two main groups:

- Field Termination Assembly (FTA) modules that are used in combination with SM chassis IO modules.
  See “FTA modules for SM chassis IO modules” on page 501.
- Termination Assembly modules that are used in combination SM universal IO modules.
  See “Termination Assembly modules for SM universal IO modules” on page 504.

FTA modules for SM chassis IO modules

This type of Field Termination Assembly (FTA) module is the interface between field components (e.g. sensors and valves) and chassis IO modules in Safety Manager.

FTA modules are connected to an IO module via a system interconnection cable (e.g. SICC-0001/Lx), which is plugged into the SIC connector on the FTA module.

Table 70 on page 501 and Table 71 on page 501 show the possible connections of field signals to IO modules.

Table 70 possible connections of input field signals to input modules

Input signals				
Field signal		SICP cable		Input module
Field signal		SICP cable	Input converter module	Input module
Field signal	FTA	SICC cable		Input module
Field signal	FTA	SICC cable	Input converter module	Input module

Table 71 possible connections of output field signals to output modules

Output signals				
Output module		SICP cable		Field signal
Output module	Output converter module	SICP cable		Field signal
Output module		SICC cable	FTA	Field signal
Output module	Output converter module	SICC cable	FTA	Field signal

Specific FTAs can only be used with particular IO or IO converter modules. Table 72 on page 502 shows possible FTA - IO module combinations and Table 73 on page 503 shows possible FTA-CP module combinations.

Table 72 possible FTA - IO module combinations

FTA module	Input module	Output module	Remarks
TSDI-1624	SDI-1624		
TSDI-1648	SDI-1648		
TSDI-16UNI	SDIL-1608 SDI-1624 SDI-1648		
TSDI-1624C	SDI-1624		
TSDI-16115	SDI-1624		
TIDI-1624	SDI-1624		
TSAI-0410	SAI-0410		
TSAI-1620m	SAI-1620m		
TSHART-1620m	SAI-1620m		with HART connection
TSGAS-1624	SAI-1620m		
TSGASH-1624	SAI-1620m		with HART connection
TSGASH-1624P	SAI-1620m		with HART connection
TSFIRE-1624	SAI-1620m		
TSDO-0824		SDO-0824	
TSDO-0824C		SDO-0824	
TDOL-0724	SDI-1624	SDO-0824	both modules are required
TDOL-0724P	SDI-1624	SDO-0824	both modules are required

Table 72 possible FTA - IO module combinations *(continued)*

FTA module	Input module	Output module	Remarks
TDOL-07120	SDI-1624	SDO-0824	both modules are required
TSDO-0424		SDO-0424	
TSDO-04UNI		SDO-0448 SDO-04110 SDOL-0424 SDOL-0448	
TSDOL-0424C		SDOL-0424	
TDO-1624		DO-1624 DO-1224	
TSRO-0824		SDO-0824	floating, non commoned, output contacts
TSRO-08UNI		SDO-0824	1 common for output contacts
TRO-0824		SDO-0824	
TRO-1024		RO-1024	
TSAO-0220m		SAO-0220m	
TSAOH-0220m		SAO-0220m	with HART connection
TPSU-2430			30 Vdc supply for other FTAs

Table 73 possible FTA-CP module combinations

FTA module	CP module	Remarks
DCOM-232/485	USI-0001 or USI-0002	Combined RS232/485 communication interface
SDW-550 EC	USI-0001 or USI-0002	5 port HSE communication FTA or "switch"

Termination Assembly modules for SM universal IO modules

This type of Termination Assembly (TA) module is the interface between field components (e.g. sensors and valves) and universal IO modules of Safety Manager.

In all cases an IO Termination Assembly (IOTA) module is required. The purpose of an IOTA module is that of a facilitator. An IOTA module provides connections for power supply and communication for either redundant or non-redundant SM universal IO modules.

For certain purposes additional TA modules may be required or benificial.

Table 74 on page 504 shows the possible combinations of TA modules and SM universal IO modules.

Table 74 possible combinations of TA, IOTA and SM universal IO modules

Field signal	TA module	Cable	IOTA module[1]	SM universal IO module
Mixed			IOTA	RUSIO or RUSLS
Mixed	TSPKUNI-1624	Yes	IOTA	RUSIO or RUSLS
Output	TDOL-0724U	Yes	IOTA	RUSIO or RUSLS

1 In this table ‘IOTA’ applies to both non-redundant and redundant applications.

TSDI-1624

Safe digital input FTA (24 Vdc, 16 channels)

Description

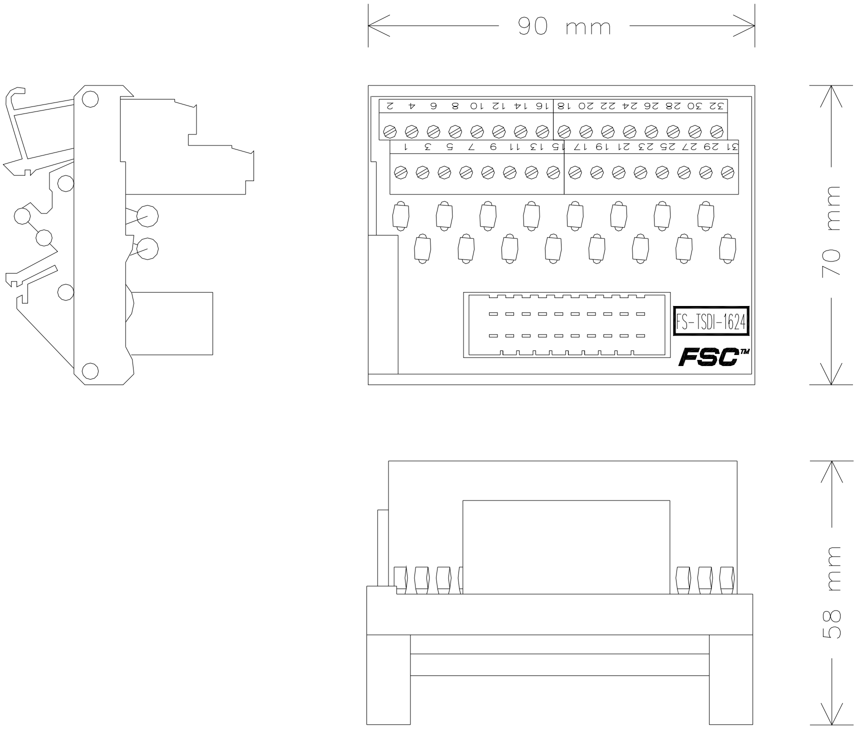
Field termination assembly module TSDI-1624 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The SICC cable interconnects the SIC connector on the FTA module and a (redundant pair of) SDI-1624 modules.

The TSDI-1624 module can interface with digital input signals from ‘Class I, Division 2 Hazardous Locations’.

The TSDI-1624 module can handle short circuits to 0 Volt of (INx+ or INx) field wires because the PTC (Positive Temperature Coefficient) resistor between the +24Vout of the SDI-1624 modules and the ‘+24Vout’ connection (INx+) of each input channel limits the current. This prevents the loss of all 16 channels (+24Vout fails) in the case of a single short circuit to 0 Volt of a connected field wire.

The FTA module has a universal snap-in provision for standard DIN EN rails and screw terminals for connecting field wiring.

Figure 300 Mechanical layout



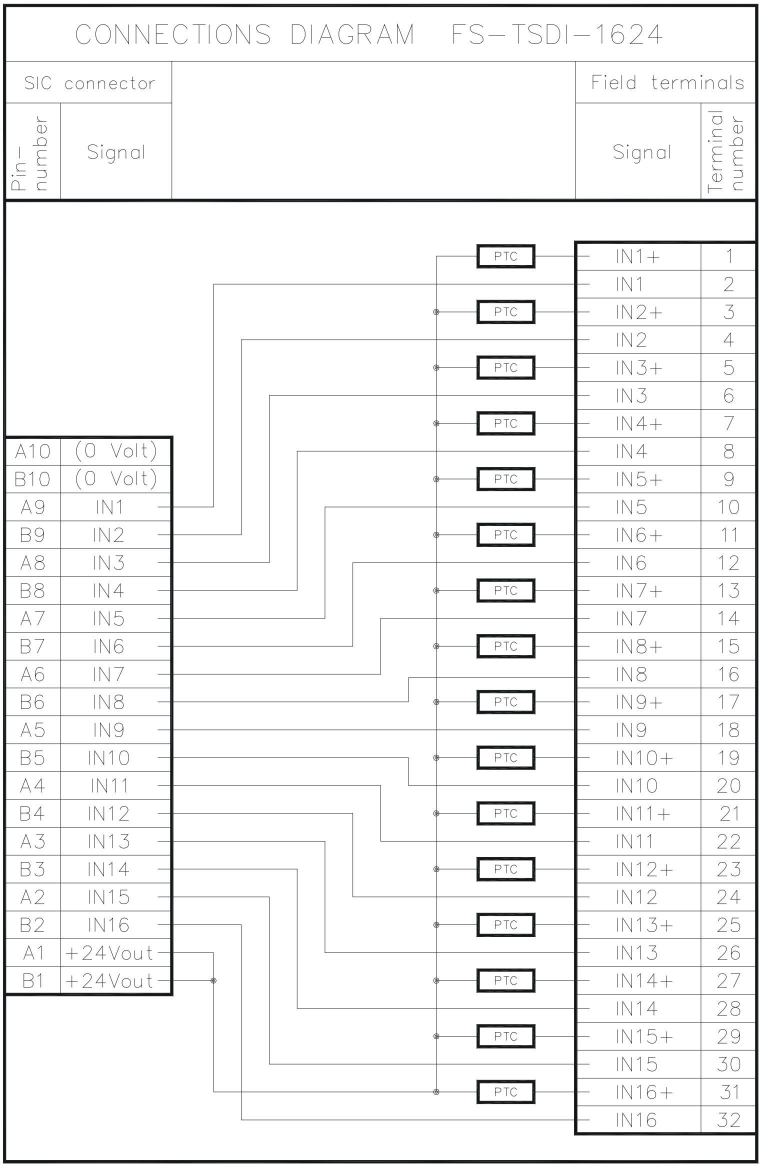
Applications

For details on applications and connection options for the TSDI-1624 module, see “SICC-0001/Lx” on page 715.

Connections

The connection diagram of the TSDI-1624 module:

Figure 301 Connection diagram



Technical data

The TSDI-1624 module has the following specifications:

General	Type numbers[1] :	FS-TSDI-1624
		FC-TSDI-1624
	Approvals:	CE, TUV, UL, CSA, FM[2]
Input	Number of input channels:	16
	Input voltage:	24 Vdc, –15%—+30%
	Input current:	≤ 15mA at 24 Vdc (with a redundant pair of SDI-1624 modules as load)
	PTC resistance:	260 Ω ±25% at 25°C
	PTC (steady) current:	typ. 45 mA ±35% at 24 Vdc
Physical	Module dimensions:	90 × 70 × 58 mm (L × W × H) 3.54 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm^2 (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb)
Field signal specifications for non-incentive field circuits Class 1 Division 2	Max. closed loop resistance:	10 Ω
	Min. open loop resistance:	15 kΩ
	HYDROGEN (GROUP A & B):	
	• max. supply voltage	28.8 Vdc
	• max. loop inductance	3 mH
	• max. loop capacitance	0.3 µF
	HYDROGEN (GROUP C & D):	
	• max. loop inductance	10 mH
	• max. loop capacitance	6 µF

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

2 FM approval is pending at the date of issue of this information. For updates contact Honeywell SMS.

TSDI-1648

Safe digital input FTA (48 Vdc, 16 channels)

Description

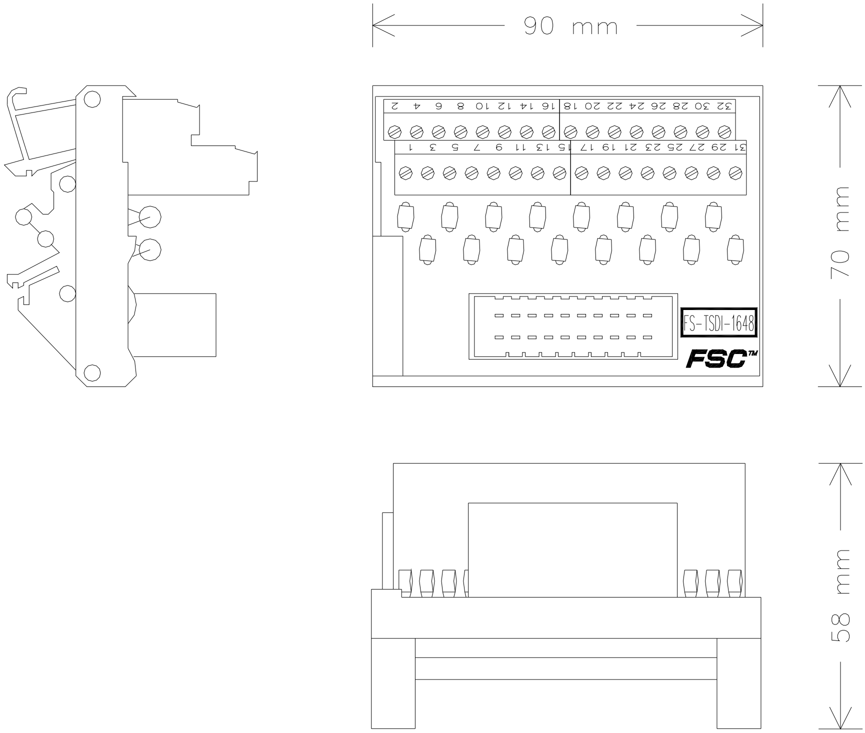
Field termination assembly module TSDI-1648 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The SICC cable interconnects the SIC connector on the FTA module and a (redundant pair of) SDI-1648 modules.

The TSDI-1648 module can interface with digital input signals from ‘Class I, Division 2 Hazardous Locations’.

The TSDI-1648 module can handle short circuits to 0 Volt of (INx+ or INx) field wires because the PTC (Positive Temperature Coefficient) resistor between the +48Vout of the SDI-1648 modules and the ‘+48Vout’ connection (INx+) of each input channel limits the current. This prevents the loss of all 16 channels (+48Vout fails) in the case of a single short circuit to 0 Volt of a connected field wire.

The FTA module has a universal snap-in provision for standard DIN EN rails and screw terminals for connecting field wiring.

Figure 302 Mechanical layout



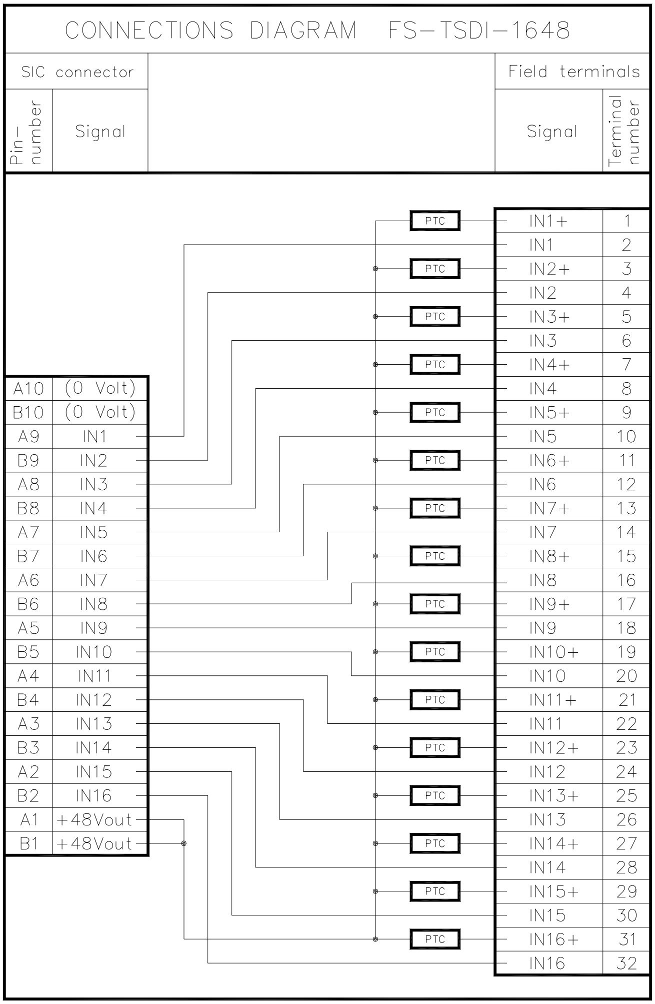
Applications

For details on applications and connection options for the TSDI-1648 module, see “SICC-0001/Lx” on page 715.

Connections

The connection diagram of the TSDI-1648 module:

Figure 303 Connection diagram



Technical data

The TSDI-1648 module has the following specifications:

General	Type numbers[1] :	FS-TSDI-1648
		FC-TSDI-1648
	Approvals:	CE, TUV, UL, CSA
Input	Number of input channels:	16
	Input voltage:	48 Vdc, –15%—+15%
	Input current:	≤ 8mA at 48 Vdc (with a redundant pair of SDI-1648 modules as load)
	PTC resistance:	1900 Ω ±25% at 25°C
	PTC (steady) current:	typ. 17 mA ±35% at 48 Vdc
Physical	Module dimensions:	90 × 70 × 58 mm (L × W × H) 3.54 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm^2 (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb)
Field signal specifications for non-incendive field circuits Class 1 Division 2	Max. closed loop resistance:	100 Ω
	Min. open loop resistance:	40 kΩ
	HYDROGEN (GROUP A & B):	
	• max. loop inductance	45 mH
	• max. loop capacitance	0.07 μF
	HYDROGEN (GROUP C & D):	
	• max. loop inductance	170 mH
	• max. loop capacitance	1 μF

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

TSDI-16UNI

Safe digital input FTA (24/48 Vdc, NAMUR, 16 channels)

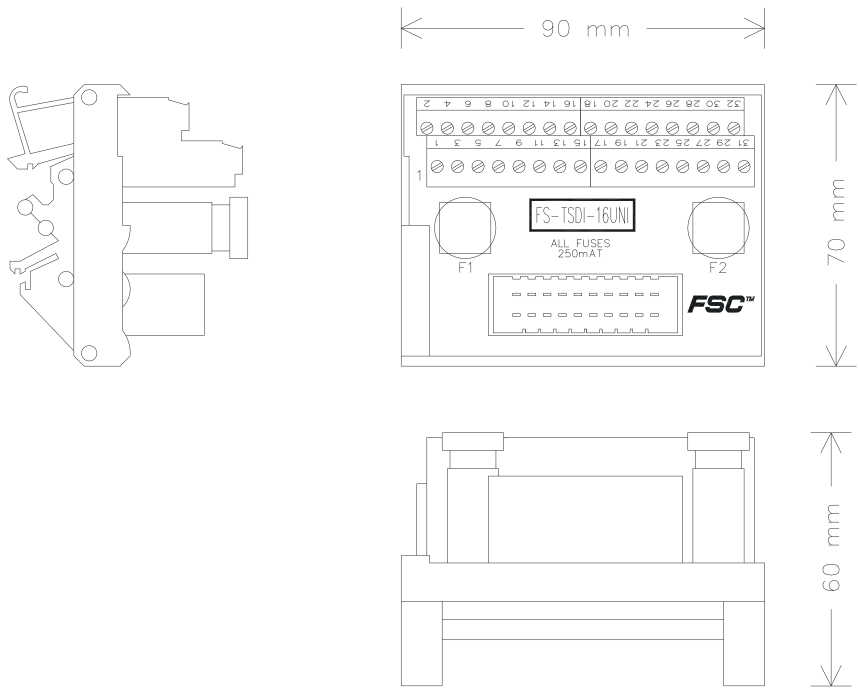
Description

Field termination assembly module TSDI-16UNI is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals).

Sixteen channels (separated into two groups of eight channels with a 250 mA fuse in the common +) can be connected to the TSDI-16UNI module via a system interconnection cable (SICC-0001/Lx). This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDIL-1608 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 304 Mechanical layout



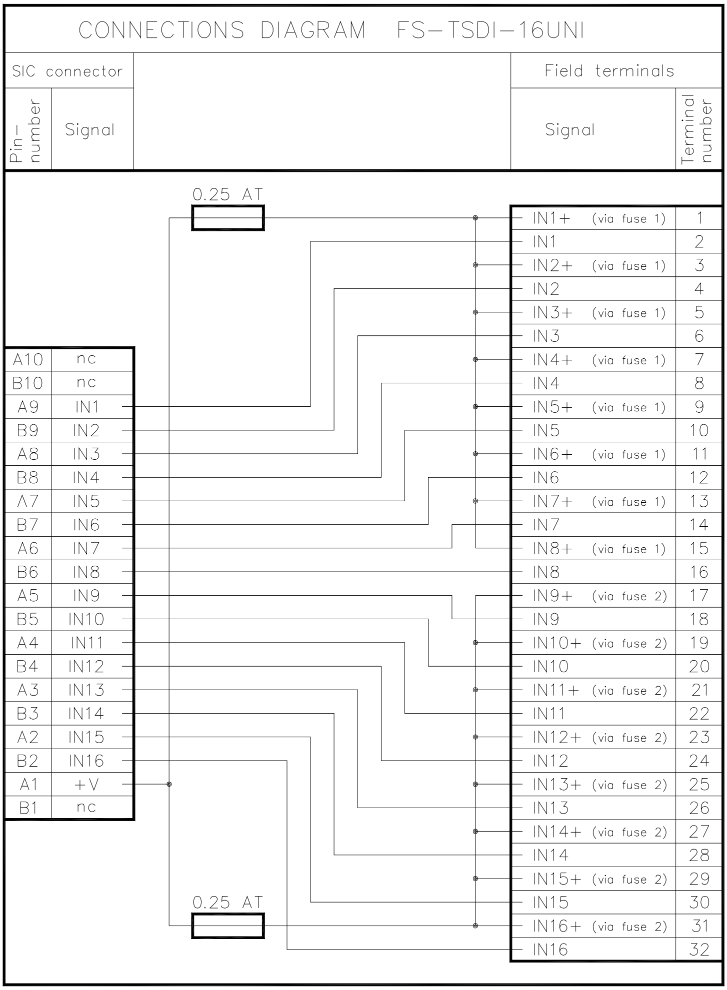
Applications

For details on applications and connection options for the TSDI-16UNI module see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSDI-16UNI module is as follows:

Figure 305 Connections diagram



Technical data

The TSDI-16UNI module has the following specifications:

General	Type numbers[1] :	FS-TSDI-16UNI
		FC-TSDI-16UNI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	16 (2 groups of 8)
	Maximum voltage:	50 Vdc – IEC 61010-1 (1990), over voltage category 3 (Table D.12) 150 Vdc – IEC 61010-1 (1990), over voltage category 2 (Table D.10)
	Actual maximum voltage defined by the connected input module	
Physical	Module dimensions:	90 × 70 × 60 mm (L × W × H) 3.54 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Fuse	Rating:	250 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.2 × 0.79 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

TSDI-1624C

Safe current-limited digital input FTA (24 Vdc, 16 channels)

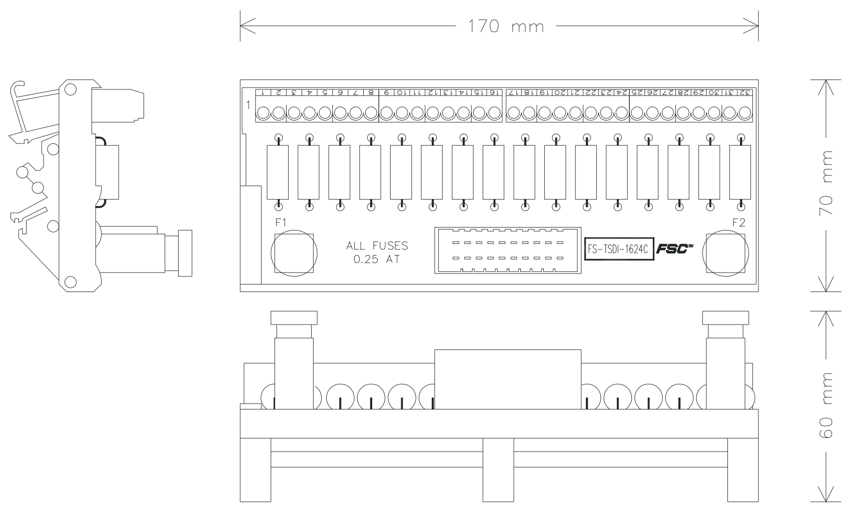
Description

Field termination assembly module TSDI-1624C is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It can be used for interfacing digital input signals from Class I, Division 2 Hazardous Locations.

Sixteen channels (separated into two groups of eight channels with a 250 mA fuse in the common +) can be connected to the TSDI-1624C module via a system interconnection cable (SICC-0001/Lx). This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 306 Mechanical layout



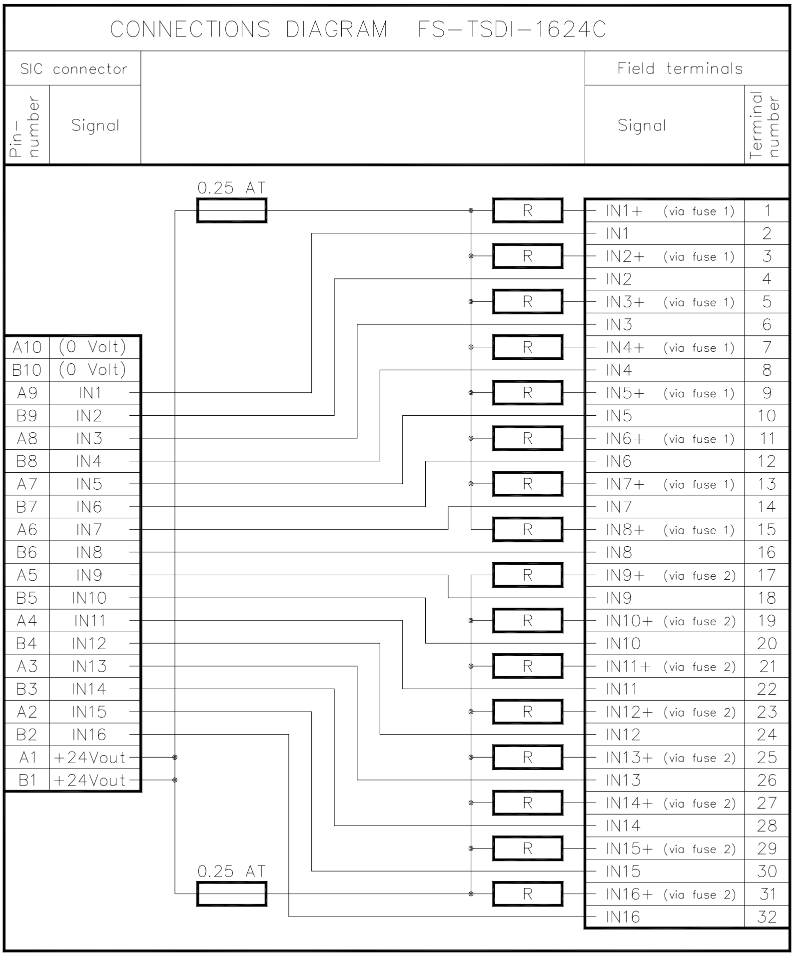
Applications

For details on applications and connection options for the TSDI-1624C module, see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSDI-1624C module:

Figure 307 Connections diagram



Technical data

The TSDI-1624C module has the following specifications:

General	Type numbers[1] :	FS-TSDI-1624C
		FC-TSDI-1624C
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8)
	Input voltage:	24 Vdc, –15%—+30%
	Input current:	≤ 15 mA at 24 Vdc (with a redundant pair of safe digital input modules SDI-1624 as load)
	Igniting current per channel:	< 100 mA at 24 Vdc +30%
Physical	Module dimensions:	170 × 70 × 60 mm (L × W × H) 6.69 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	171 mm
Fuse	Rating:	250 mAT (slow acting)
	Dimensions:	5 × 20 mm (0.2 × 0.79 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Field signal specifications for non-incendiary field circuits to Class 1 Division 2	Max. closed loop resistance:	250 Ω
	Min. open loop resistance:	15 kΩ
	HYDROGEN (Group A & B):	
	• Max. loop inductance	8 mH
	• Max. loop capacitance	0.3 µF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	22 mH
	• Max. loop capacitance	7 µF

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

TSDI-16115

Safe active/passive digital input FTA (115 Vac/dc, 16 channels)

Description

Field termination assembly module TSDI-16115 is a 16-channel safe input converter module, universal for both 115 Vac and/or 115 Vdc. All inputs are galvanically isolated.

Each channel converts an externally supplied 115 V input signal into a 24 Vdc input signal which can be connected to the 24 Vdc safe input module SDI-1624, thus creating a safe 115 V input for Safety Manager.

Sixteen channels can be connected to the TSDI-16115 module via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 308 Mechanical layout

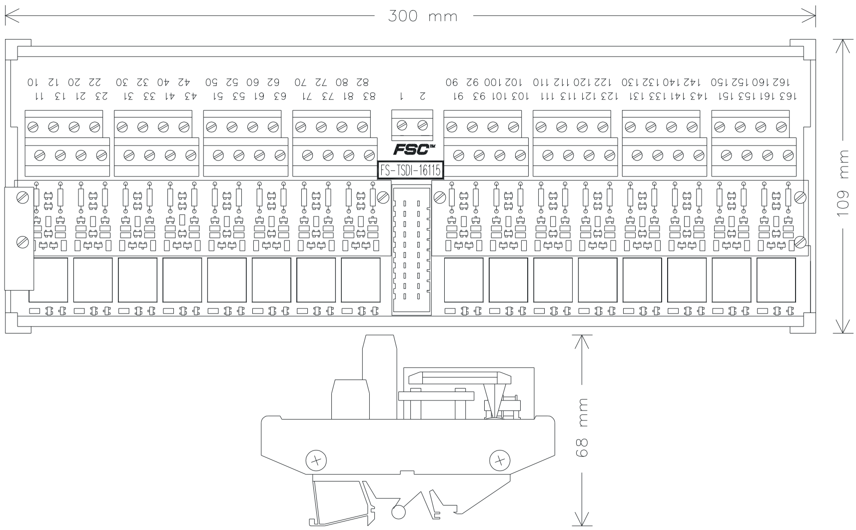
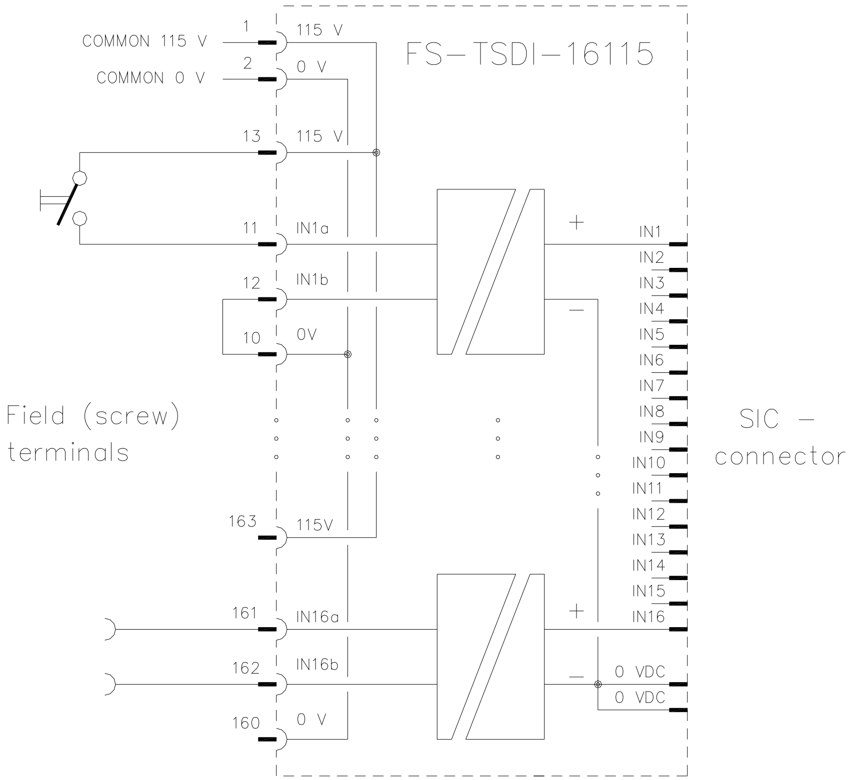


Figure 309 Schematic diagram



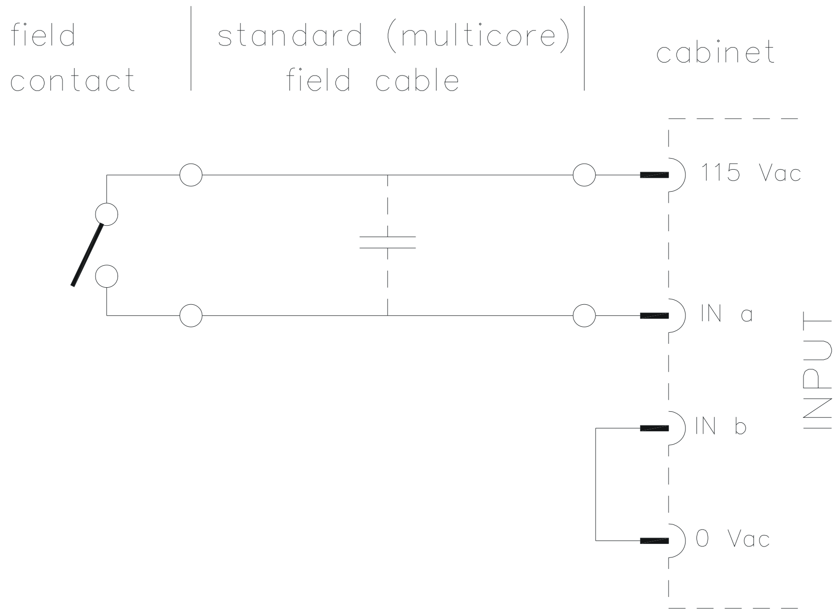
Applications

For details on applications and connection options for the TSDI-16115 module see section “SICC-0001/Lx” on page 715.

Field cable lengths

High-impedance AC inputs (like the inputs on this FTA) have a limited capability of handling the wire capacitance of standard multi-core field cables. The wire capacitance of the field cable acts as a shunt impedance over the field contact (see Figure 310 on page 521).

Figure 310 Standard (multi-core) field cable



When the current through this shunt impedance exceeds the maximum ‘LOW’ current, the input may be activated by this shunt impedance, thus disabling the input function (by keeping the input activated continuously, i.e. ON). Every AC input will have a maximum ‘LOW’ current that it can handle.

The maximum allowable cable length depends on the maximum ‘LOW’ current (for example 1.2 mA), the typical cable capacitance (for example 120 pF/m), the maximum supply voltage (for example 130 Vac) and the supply frequency (for example 60 Hz).

The maximum length (in meters) can be calculated using the following formula:

$$L_{max} = \frac{I_{low}}{V_{max} \cdot 2 \cdot \pi \cdot f \cdot C_{typ}}$$

where:

L_{max} = maximum allowable cable length

I_{low} = maximum ‘LOW’ current

V_{max} = maximum supply voltage

f = supply frequency

C_{typ} = typical cable capacitance

As an example, we will calculate the maximum field cable length (in meters) using the values mentioned above:

$$L_{max} = \frac{1.2 \cdot 10^{-3}}{130 \cdot 2 \cdot \pi \cdot 60 \cdot (120 \cdot 10^{-12})} = 204\ \text{m}$$

In this example, the maximum allowable field cable length is 204 meters (223 yards).

The field cable length limit can be eliminated by using field cables with wires that are shielded separately (see Figure 311 on page 522). The only (relevant) capacitance of the input wire is to the shield (0 Vac or earth) and this will not activate a 'LOW' input. However, this type of cable is rather unusual.

Field cables with shielded wire pairs are more commonly used (see Figure 312 on page 523). This allows for two connections methods:

1. Use the method of Figure 311 on page 522 and leave the second wire of each pair unconnected, or
2. Connect the second wire of each pair to 0 Vac (as shown in Figure 312 on page 523). The 115 Vac / 0 Vac supply pair can be used for more than one input.

Figure 311 Field cable with separately shielded wires

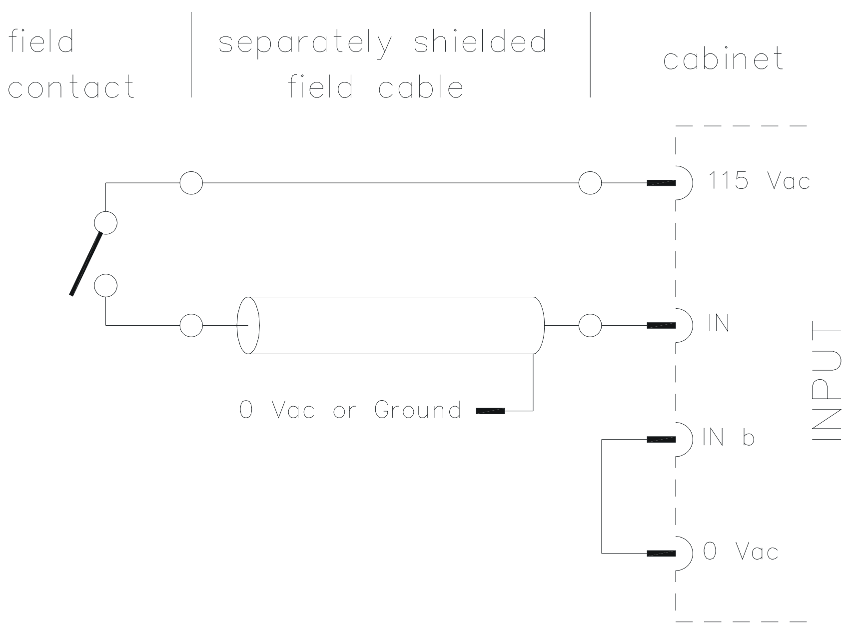
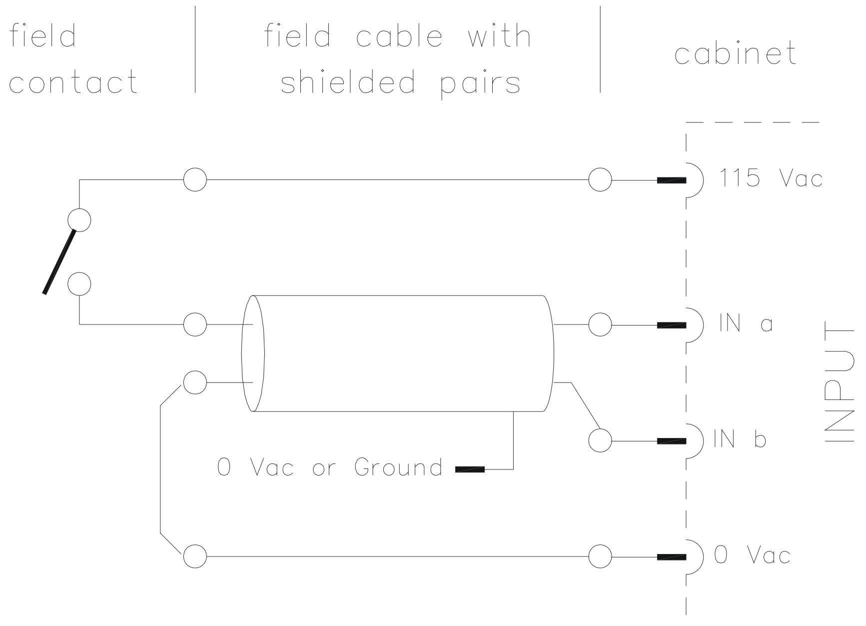


Figure 312 Field cable with shielded pairs



In practice, a mix of wiring methods may be used. For example, use a cable with shielded pairs between the control cabinet and a distribution box close to the process. This cable may be long, for example 3 km (1.8 mi). Then use a standard (multi-core) cable for the connection between the distribution box and the field contact. This cable length is limited to the value calculated using the formula mentioned above.

Connecting active / passive inputs

The TSDI-16115 module supports inputs for both active and passive signals. Figure 313 on page 524 shows the schematic diagram for connecting active inputs. Figure 314 on page 525 shows the diagram for connecting passive inputs.

Figure 313 Schematic diagram for connecting active inputs

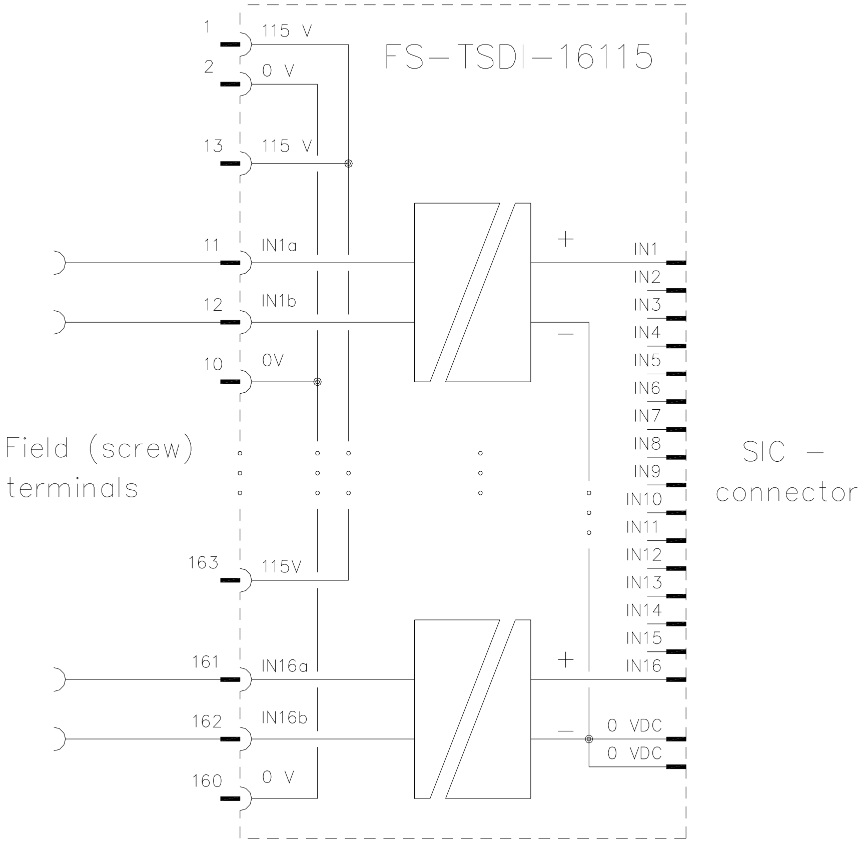
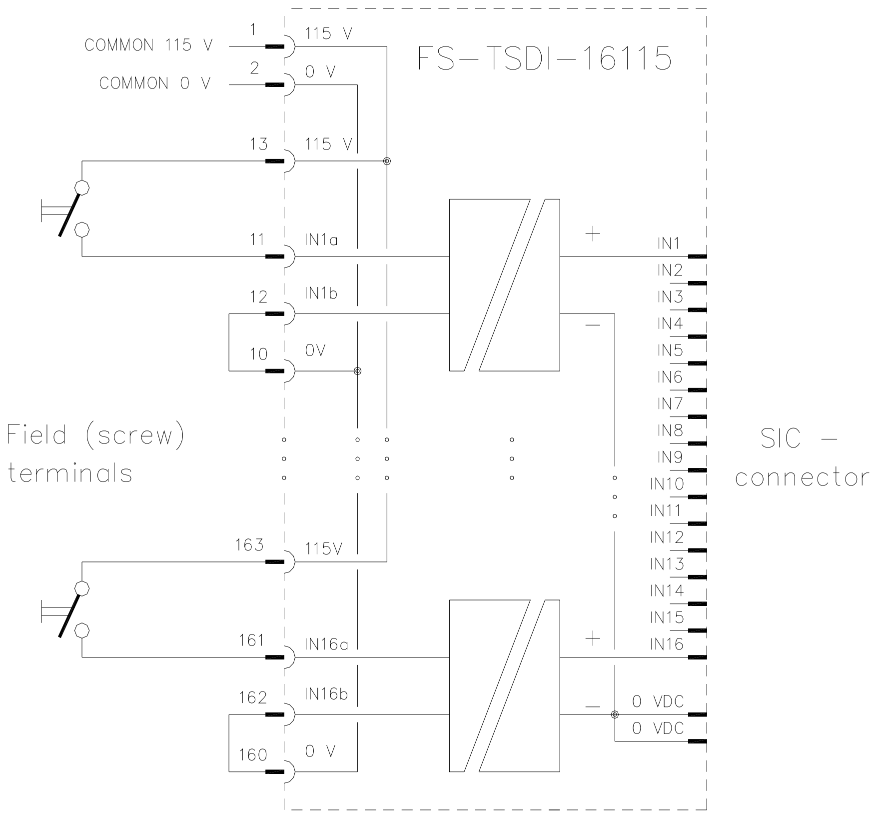


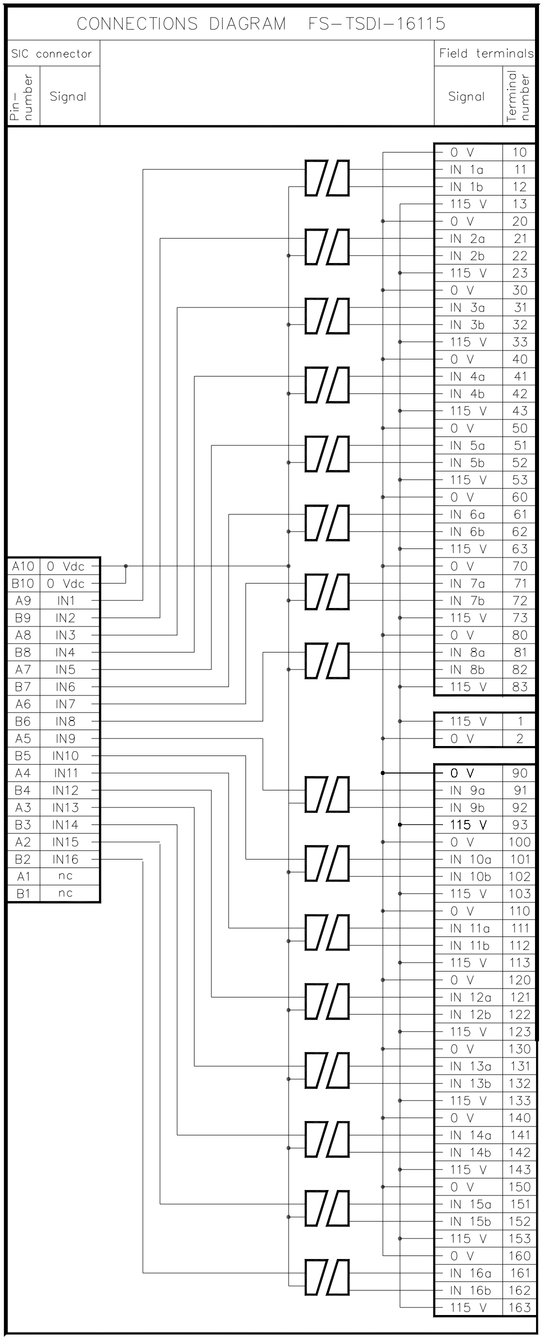
Figure 314 Schematic diagram for connecting passive inputs



Connections

The connections diagram of the TSDI-16115 module is as follows:

Figure 315 Connections diagram



Technical data

The TSDI-16115 module has the following specifications:

General	Type numbers[1] :	FS-TSDI-16115
		FC-TSDI-16115
	Approvals:	UL, CE, TUV, CSA
Input	Number of input channels:	16
	Input voltage:	115 V, –15%—+30%
	Input frequency:	DC or 40—300 Hz
	Input current:	7.5 mA (± 1 mA) at 115 V
	Input impedance:	non-inductive, > 9 kΩ
	Input LOW:	U ≤ 15 V or I ≤ 1.2 mA *(see "Field cable lengths" on page 520 in this data sheet)*
Physical	Module dimensions:	300 × 109 × 68 mm (L × W × H) 11.81 × 4.29 × 2.68 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	301 mm (11.85 in)
Environment	Max. ambient temperature:	50°C (122°F) at 115 V, –15% — +30%
		60°C (140°F) at 115 V, –15%—+10%
		70°C (158°F) at 115 V, –15%—+0%
Isolation	Isolation input to output:	2 kV
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

TIDI-1624

Non-safe Isolated passive digital input FTA (16 channels)

Description

Field termination assembly module TIDI-1624 is the interface between the system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has sixteen non-safe isolated 24 Vdc input channels.

Sixteen channels can be connected to the TIDI-1624 module via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module and connects to a (redundant pair of) SDI-1624 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 316 Mechanical layout

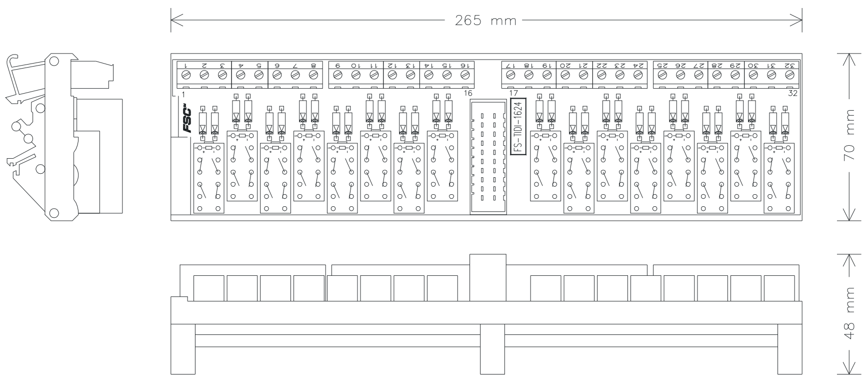
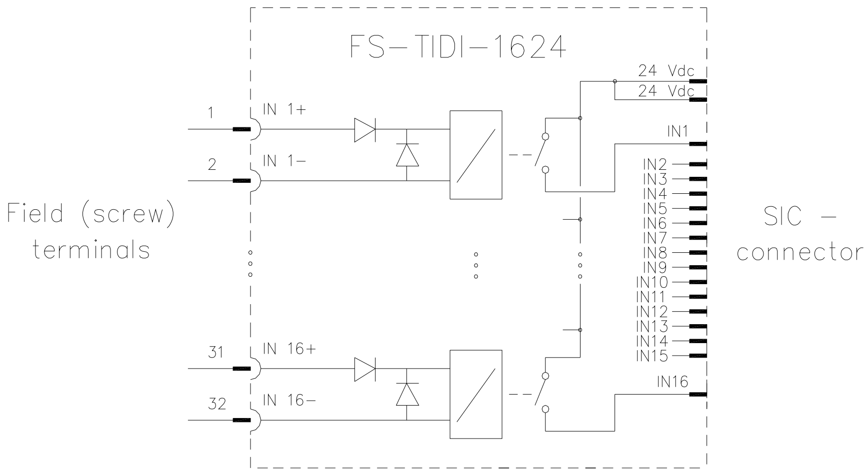


Figure 317 Schematic diagram



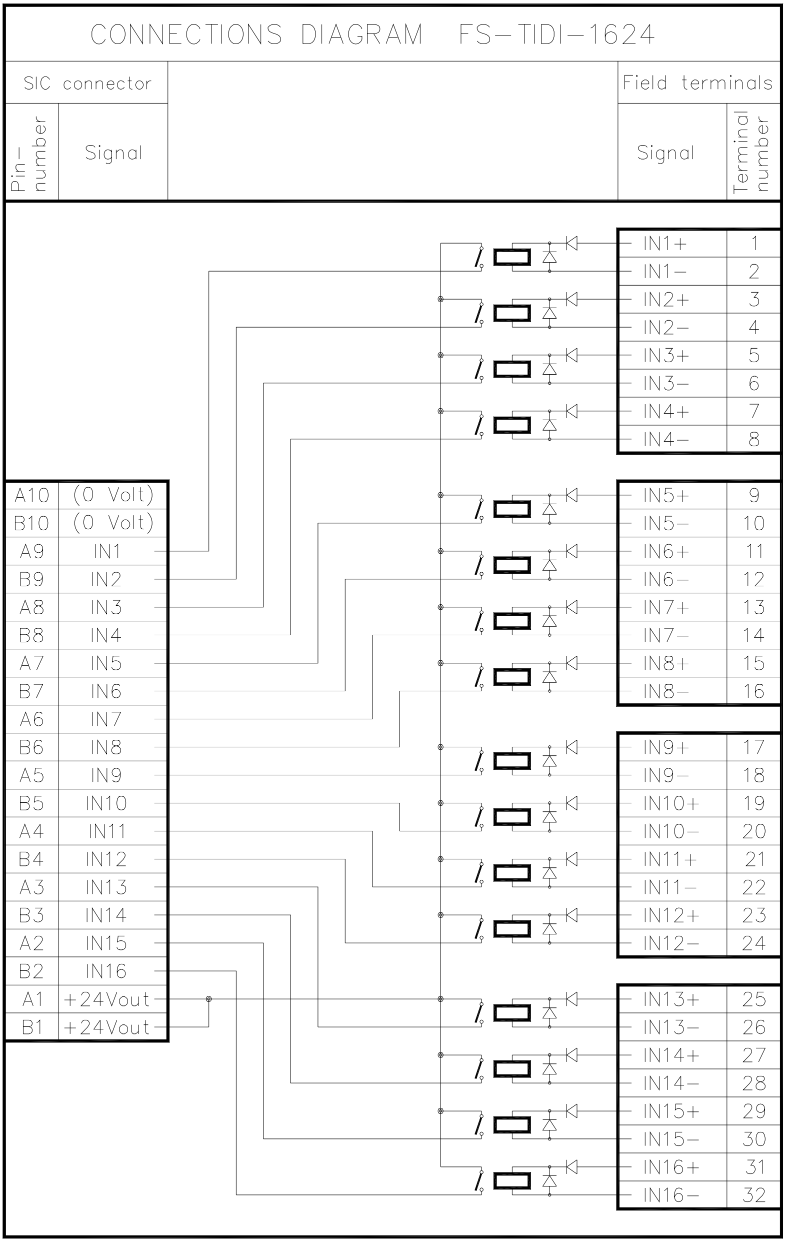
Applications

For details on applications and connection options for the TIDI-1624 module, see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TIDI-1624:

Figure 318 Connections diagram



Technical data

The TIDI-1624 module has the following specifications:

General	Type numbers[1] :	FS-TIDI-1624
		FC-TIDI-1624
	Approvals:	CE, TUV, UL, CSA
Input	Number of input channels:	16
	Nominal input voltage:	24 Vdc
	Drop-out voltage:	2.8 Vdc
	Pick-up voltage:	17.5 Vdc
	Max. input voltage:	47.5 Vdc
	Reverse polarity protection:	Series diode
	Max. reverse voltage:	300 V
	Input current:	Typically 9 mA at 24 Vdc
	Max. switching frequency:	20 Hz
Physical	Module dimensions:	265 × 70 × 48 mm (L × W × H) 10.43 × 2.76 × 1.89 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	266 mm (10.47 in)
Relay contact	Expected life: • electrical • mechanical	 1,000,000 switch operations 10,000,000 switch operations
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Isolation	Galvanic isolation:	
	• Input to output	1000 Vac
	• Input to input	1000 Vac

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules.

TSAI-0410

Safe analog input FTA (4 channels)

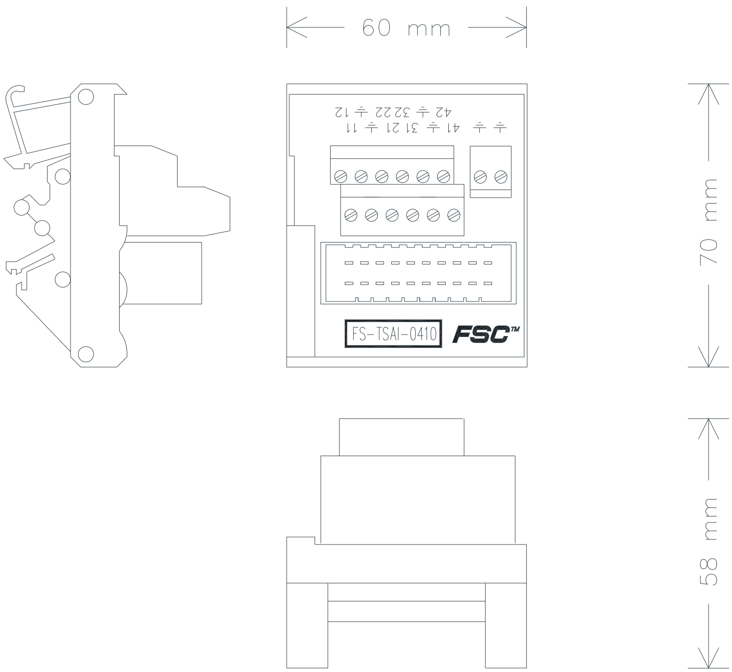
Description

Field termination assembly module TSAI-0410 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals).

The four channels of a (redundant pair of) SAI-0410 module(s) can be connected to the TSAI-0410 module via system interconnection cable SICC-0001/Lx. Range selection (active, passive, volts/current) is set per module (4 channels) using an BSAI-04x or BSDIL-0426 board.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 319 Mechanical layout



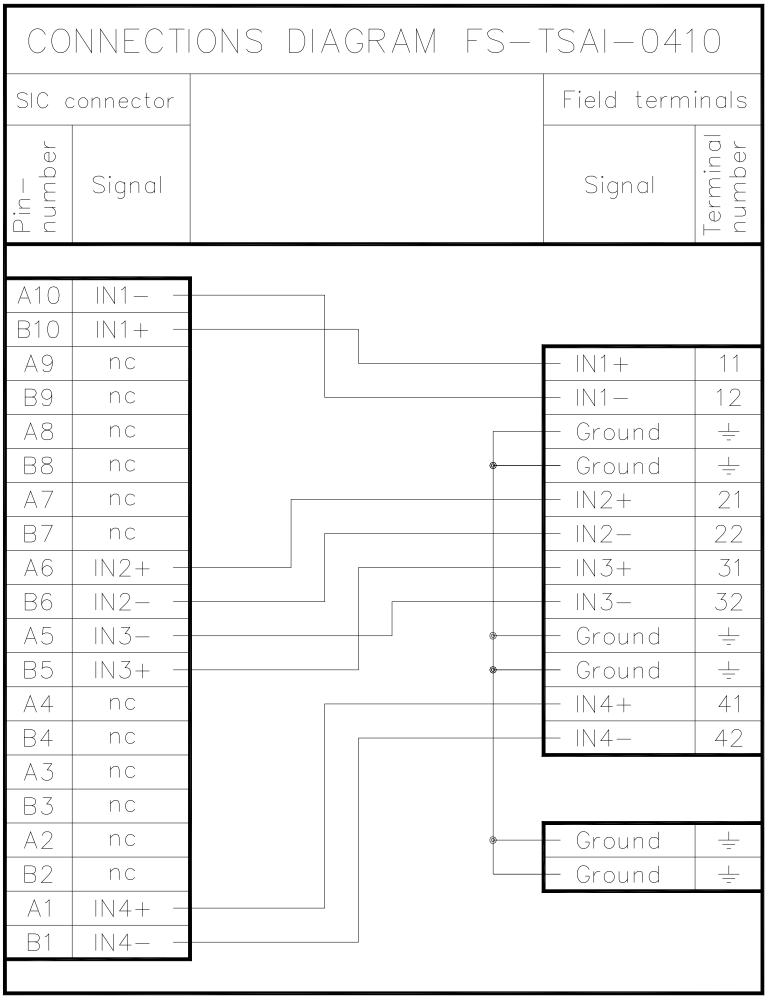
Applications

For details on applications and connection options for the TSAI-0410 module, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSAI-0410 module is as follows:

Figure 320 Connections diagram



Technical data

The TSAI-0410 module has the following specifications:

General	Type numbers[1] :	FS-TSAI-0410
		FC-TSAI-0410
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	4
	Maximum voltage:	50 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current/voltage per channel:	50 mA (for 0(4)—20 mA setting) 10 V (for 0(2)—10V setting)
Physical	Module dimensions:	60 × 70 × 58 mm (L × W × H) 2.36 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

TSAI-1620m

Safe 0-20 mA and 4-20 mA analog input FTA (16 channels)

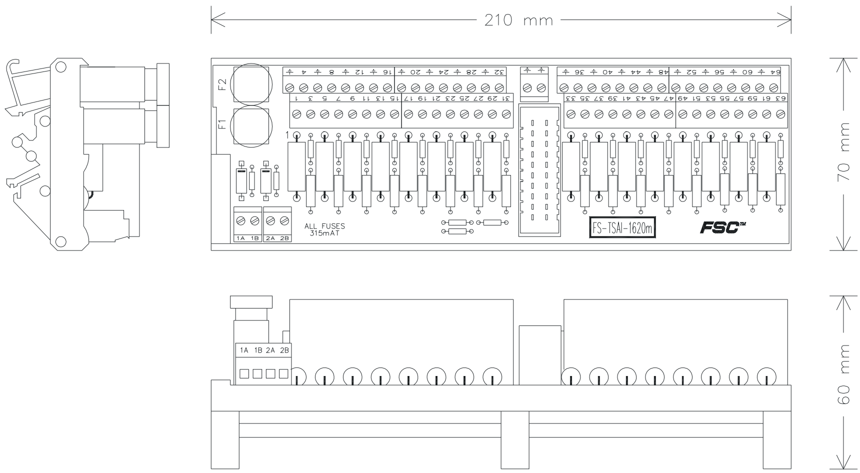
Description

Field termination assembly module TSAI-1620m is the interface between field components (such as sensors) and the safe high-density analog input module SAI-1620m in Safety Manager. It can be used for interfacing signals from Class I, Division 2 Hazardous Locations.

The TSAI-1620m module has sixteen analog input channels, which may be used for both safety-related and non-safety-related applications. These sixteen channels (separated into two groups of eight channels with common 0 V) are connected via a system interconnection cable (SICC-0001/Lx), which is plugged into the SIC connector on the FTA module.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

Figure 321 Mechanical layout



Main functions

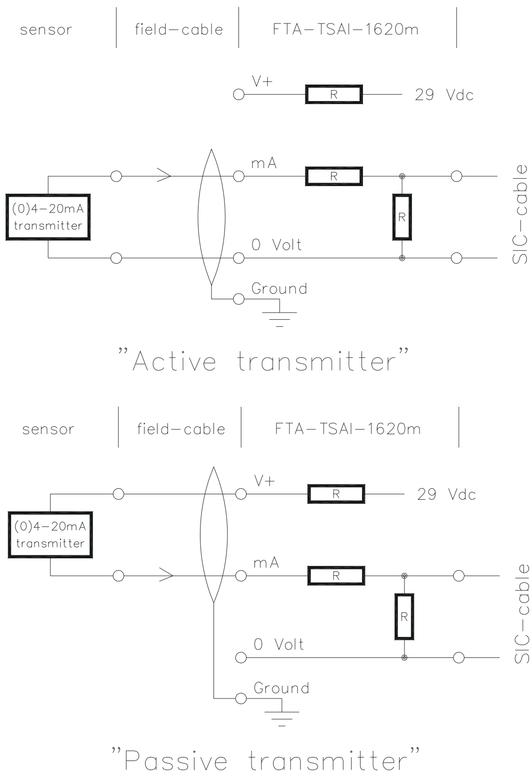
TSAI-1620m module has three main functions:

- Linear direct conversion of 0(4)—20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Enabling monitoring of the external power connected to the FTA module

Linear direct conversion

The input circuit of each channel consists of a high-precision resistor, which converts the input current (0—20 mA) to the input voltage for the high-density analog input module SAI-1620m. Power is supplied to the analog transmitter via a series resistor. Each analog signal has its own terminal for the field cable shield. Figure 322 on page 536 shows the schematic diagram for connecting a transmitter (active and passive).

Figure 322 Schematic diagram for connecting a transmitter



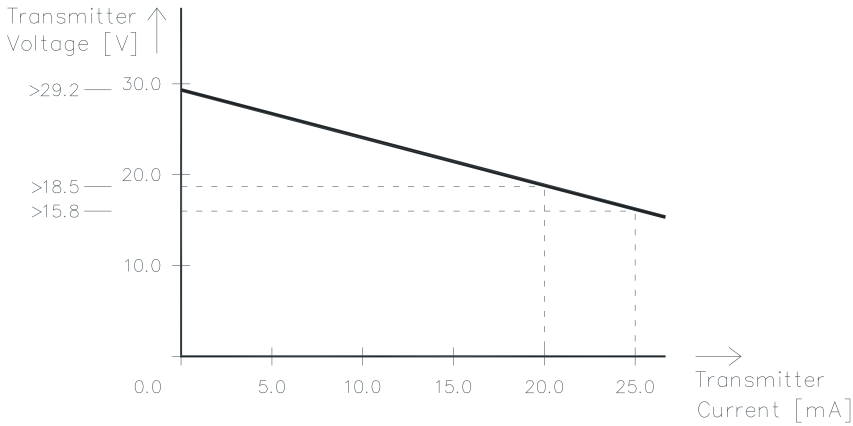
Class I division 2

The TSAI-1620m module may be used for non-incendiary field circuits for Class I, Division 2 applications. The external output voltage (V+) is current-limited by means of a series resistor.

Transmitter voltage

Figure 323 on page 537 shows the available transmitter voltage for passive transmitters.

Figure 323 Transmitter voltage for passive transmitters



External power

If all inputs are active, no external power is required.

For loops, which contain passive transmitters, analog process data is only available if the supply voltage to the electronics is guaranteed. The high-density analog input concept (using TSAI-1620m / TPSU-2430 modules) offers full monitoring of power that is provided externally. If DC/DC converter modules TPSU-2430 are used, even redundant power supplies are covered.

Redundant external power can be connected to the TSAI-1620m module via two screw terminal pairs marked ‘1A’, ‘1B’, ‘2A’ and ‘2B’. The external power supplies are de-coupled via diodes (see Figure 324 on page 538). The sixteen channels on the FTA module are divided into two groups of eight channels, with each group being protected by a 315 mA fuse. Single-channel errors (shorts from V+ to 0 V) cannot blow the group fuse.

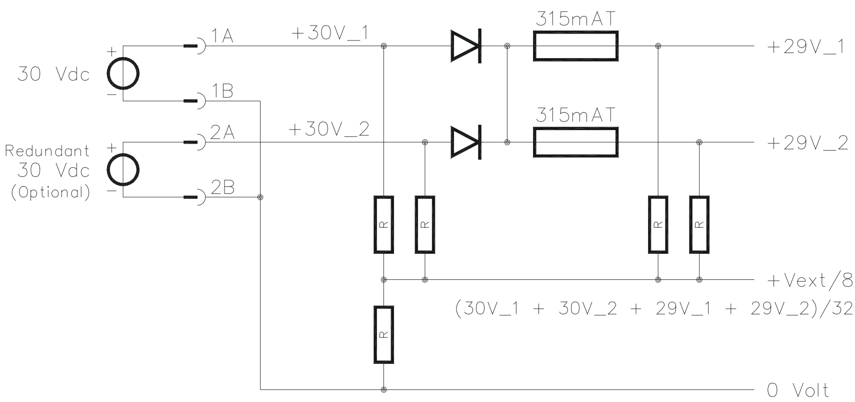
Note

The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager application software must monitor the external power voltage via the safe high-density analog input module SAI-1620m when safety-related analog input signals are connected to the TSAI-1620m.

Figure 324 on page 538 shows the schematic diagram for power distribution with monitoring.

Figure 324 Schematic diagram for power distribution with monitoring



Applications

For details on applications and connection options for the TSAI-1620m module, see section “SICC-0001/Lx” on page 715.

Connections

External power and ground

The redundant external supply voltage (Vext) and ground are connected to the following screw terminals (marked '1A', '1B', '2A', '2B' and '⏚' on the FTA):

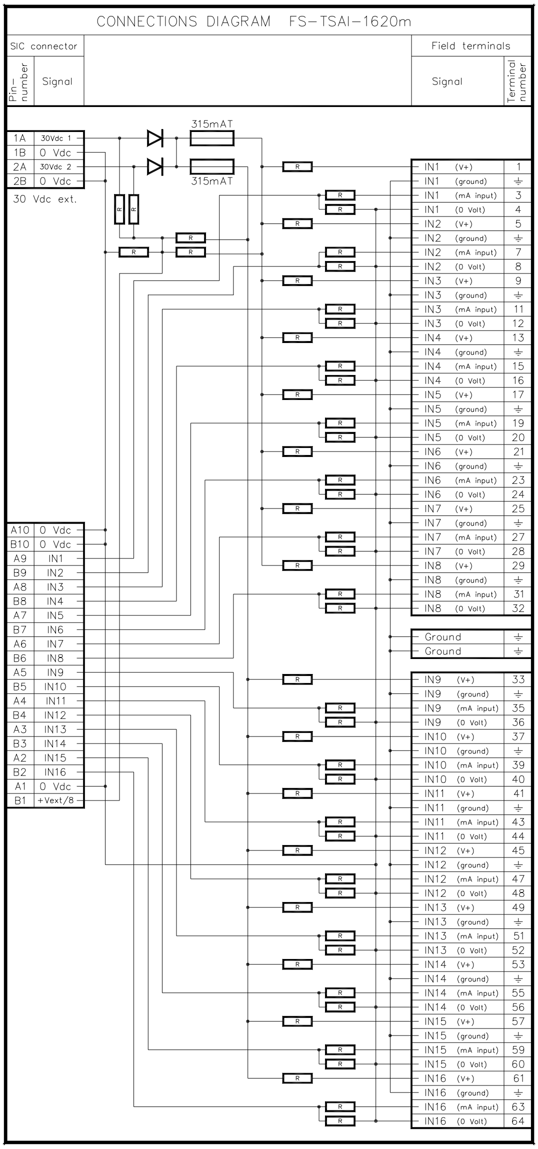
Screw terminal	Function
1A	30 Vdc Vext feeder 1
1B	0 Vdc Vext feeder 1
2A	30 Vdc Vext feeder 2
2B	0 Vdc Vext feeder 2
⏚	Ground connection
⏚	Ground connection (1 ground wire is enough)

Connections diagram

TSAI-1620m has 16 groups (= 16 channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

The connections diagram of the TSAI-1620m module:

Figure 325 Connections diagram



Technical data

The TSAI-1620m module has the following specifications:

General	Type numbers[1] :	FS-TSAI-1620m
		FC-TSAI-1620m
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8 with common 0 V)
	Power requirements:	30 Vdc external, 3 mA (without input loop loads)
	Input current:	0—25 mA
	Input resistance:	250 Ω (± 1%)
Output	To passive transmitters (Vext):	
	• Output resistance:	270 Ω (± 5%)
	• Igniting current per channel:	< 120 mA at 30 Vdc
	To SAI-1620m module:	
	• Output voltage	0—4 Vdc
	• Accuracy	0.1%
Fuses	Rating:	315 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	210 × 70 × 60 mm (L × W × H) 8.26 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	211 mm (8.30 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

The TSAI-1620m module has the following for non-incendive field circuits, Class1 Division 2 specifications:

Field signal specifications for non-incendive field circuits, Class1 Division 2	HYDROGEN (Group A & B):	
	• Max. loop inductance	6 mH
	• Max. loop capacitance	0.25 µF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	20 mH
	• Max. loop capacitance	5 µF

TSHART-1620m

Safe 0-20 mA and 4-20 mA analog input FTA with HART interface (16 channels)

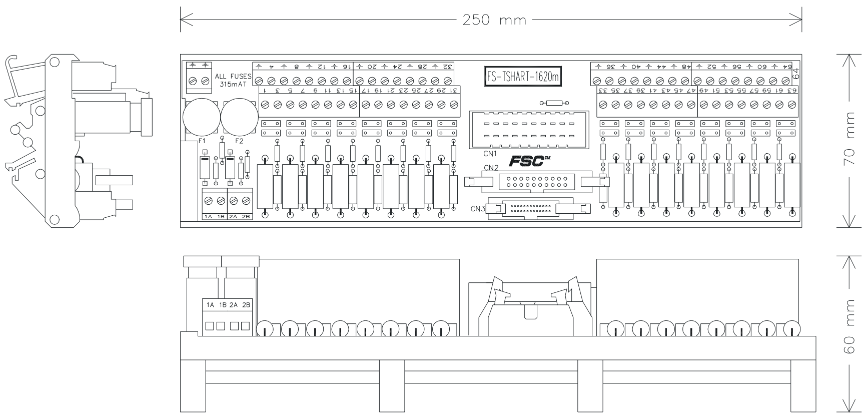
Description

Field termination assembly module TSHART-1620m is the interface between field components (sensors, etc.) and the safe high-density analog input module SAI-1620m in Safety Manager. The FTA provides HART interface. It can be used for interfacing signals from Class I, division 2 Hazardous Locations.

The TSHART-1620m module has sixteen analog input channels, which may be used for both safety-related and non-safety-related applications. These sixteen channels (separated into two groups of eight channels with common 0 V) are connected via a system interconnection cable (SICC-0001/Lx), which is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

Figure 326 Mechanical layout



Main functions

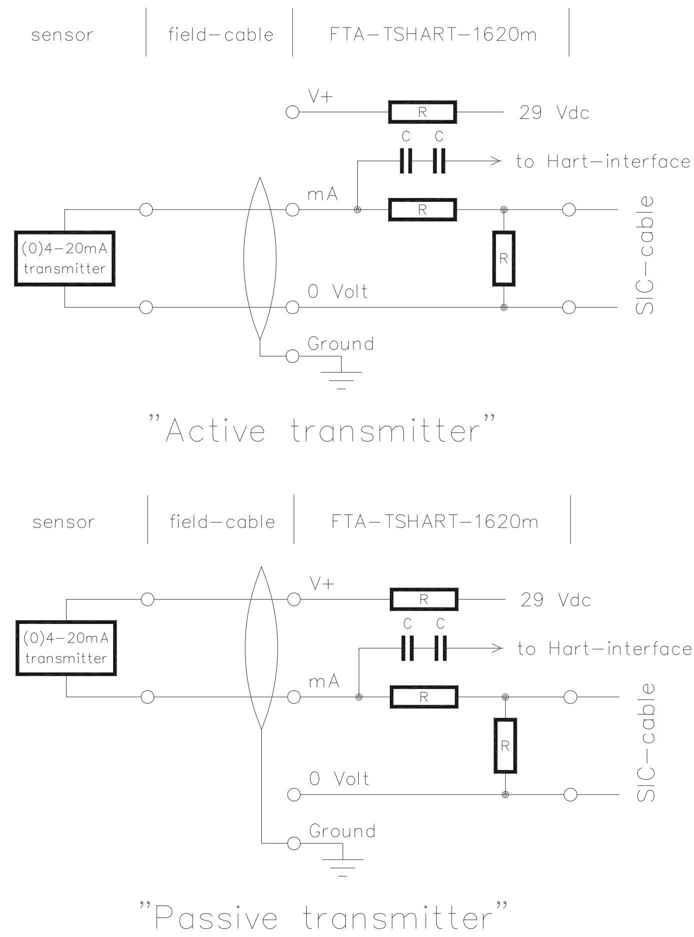
The TSHART-1620m module has four main functions:

- Linear direct conversion of 0(4)—20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Enable connection to HART multiplex units of MTL or Pepperl+Fuchs (P+F)
- Power supply distribution to each transmitter with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Enable monitoring of the external power connected to the FTA module

Linear direct conversion

The input circuit of each channel consists of a high-precision resistor, which converts the input current (0—20 mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is supplied via a series resistor. Each analog signal has its own terminal for the field cable shield. Figure 327 on page 545 shows the schematic diagram for connecting a transmitter (active and passive).

Figure 327 Schematic diagram for connecting a transmitter



HART interface

Warning:

Suggested HART multiplexers have *no* galvanic isolation between (24 Vdc) supply and the HART signals (common 0 Vdc).

The TSHART-1620m module provides an interface to HART multiplex units from MTL and P+F. Special connectors are installed on the FTA for connection of the standard cables from these suppliers.

The following connections and equipment can be used:

MTL solution:

- Multiplex unit MTL4842
- Cable: MTL FLAT20-2.2
- Connector on FTA: CN2 (see Figure 326 on page 543)

P+F solution:

- Multiplex unit KFD0-HMS-16 or KFD2-HMM-16
- Cable: K-HM26
- Connector on FTA: CN3 (see Figure 326 on page 543)

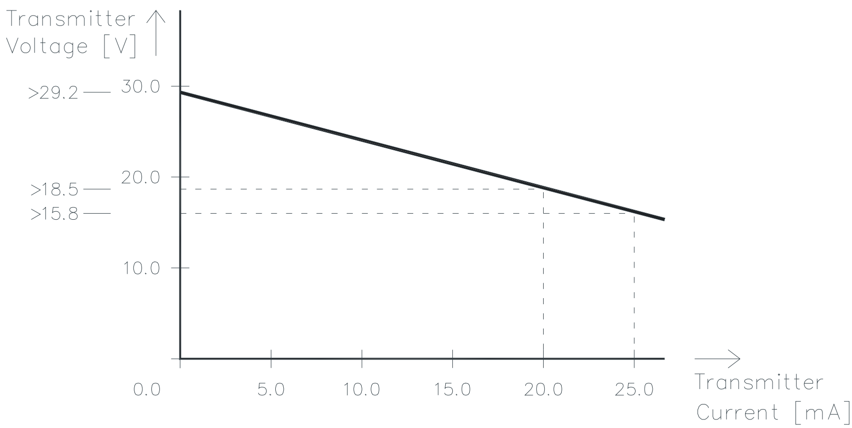
Class I division 2

The TSHART-1620m module may be used for non-incendiary field circuits to Class I, division 2 applications. The external output voltage (V+) is current-limited by means of a series resistor.

Transmitter voltage

Figure 328 on page 546 shows the available transmitter voltage for passive transmitters.

Figure 328 Transmitter voltage for passive transmitters



External power

If all inputs are active, no external power is required.

For loops, which contain passive transmitters, analog process data is only available if the supply voltage to the electronics is guaranteed. The high-density analog input concept (using TSHART-1620m / TPSU-2430 modules) offers full monitoring of power that is provided externally. If DC/DC converter modules TPSU-2430 are used, even redundant power supplies are covered.

Redundant external power can be connected to the TSHART-1620m module via two screw terminal pairs marked ‘1A’, ‘1B’, ‘2A’ and ‘2B’. The screw terminal pairs are interconnected on the FTA module but de-coupled via diodes. The sixteen channels on the FTA module are divided into two groups of eight channels, with each group being protected by a 315 mA fuse. Single-channel errors (shorts from V+ to 0 V) cannot blow the group fuse.

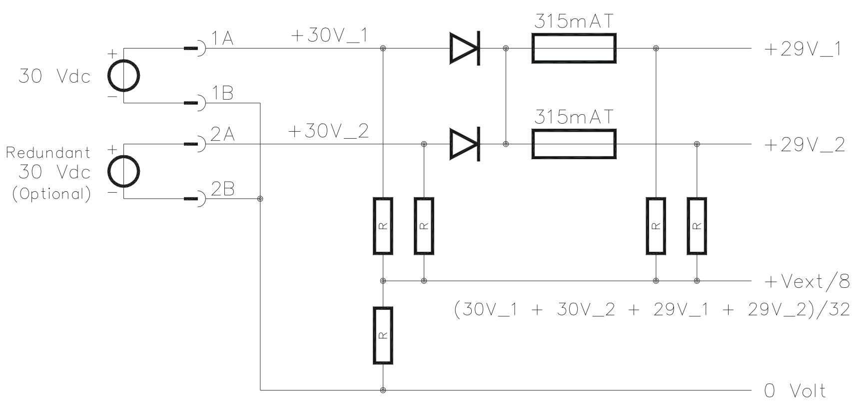
Note

The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager application software must monitor the external power voltage via the safe high-density analog input module SAI-1620m when safety-related analog input signals are connected to the TSHART-1620m.

Figure 329 on page 547 shows the schematic diagram for power distribution with monitoring.

Figure 329 Schematic diagram for power distribution with monitoring



Applications

For details on applications and connection options for the TSHART-1620m module see “SICC-0001/Lx” on page 715.

Connections

External power and ground

The redundant external supply voltage (Vext) and ground are connected to the following screw terminals (marked ‘1A’, ‘1B’, ‘2A’, ‘2B’ and ‘⏚’ on the FTA):

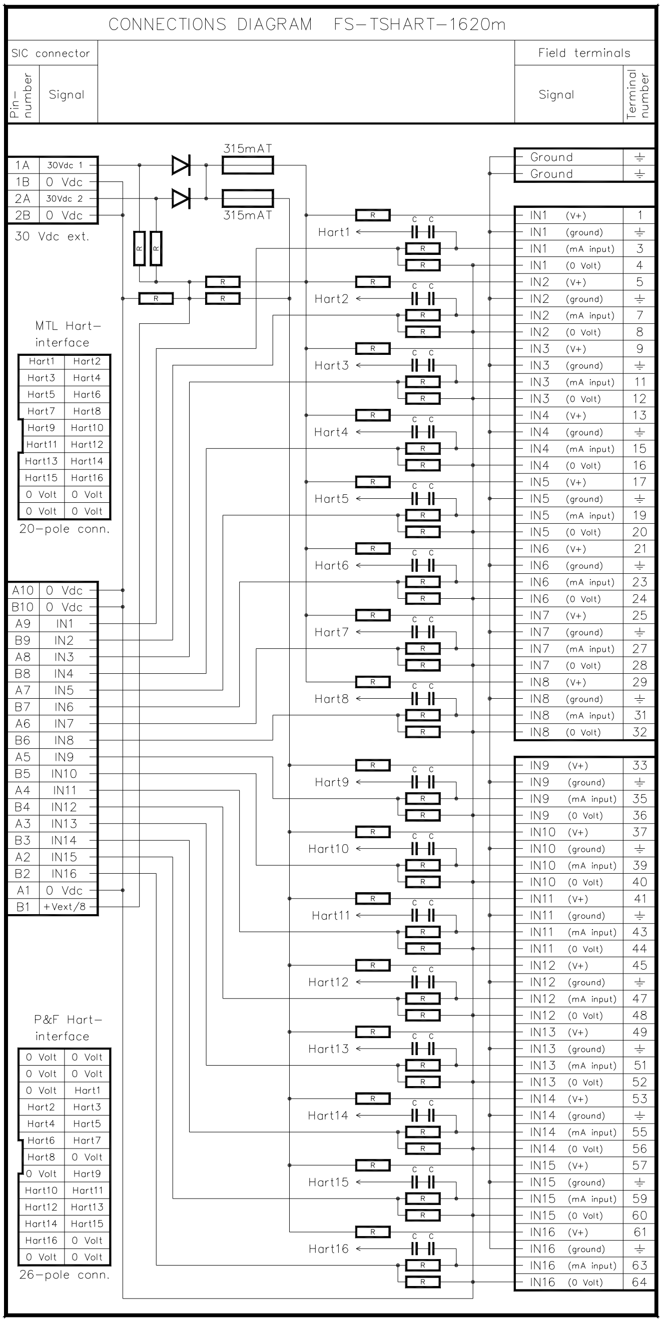
Screw terminal	Function
1A	30 Vdc Vext feeder 1
1B	0 Vdc Vext feeder 1
2A	30 Vdc Vext feeder 2
2B	0 Vdc Vext feeder 2
⏚	Ground connection
⏚	Ground connection (1 ground wire is enough)

Connections diagram

Figure 330 on page 549 shows the connections diagram of the TSHART-1620m module.

The TSHART-1620m module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

Figure 330 Connections diagram



Technical data

The TSHART-1620m module has the following general specifications:

General	Type numbers[1] :	FS-TSHART-1620m
		FC-TSHART-1620m
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (2 groups of 8 with common 0 V)
	Power requirements:	30 Vdc external, 3 mA (without input loop loads)
	Input current:	0—25 mA
	Input resistance:	250 Ω (± 1%)
Output	To passive transmitters (Vext):	
	• Output resistance:	270 Ω (± 5%)
	• Igniting current per channel:	< 120 mA at 30 Vdc
	To SAI-1620m module:	
	• Output voltage	0—4 Vdc
	• Accuracy	0.1%
	To HART multiplex unit:	
	• Output voltage	Max. 5 V peak-peak
	• Series impedance	> 100 nF
Fuses	Rating:	315 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	250 × 70 × 60 mm (L × W × H) 9.84 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	251 mm (9.87 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

The TSHART-1620m module has the following specifications for non-incendive field circuits, Class1 Division 2:

Field signal specifications for non-incendive field circuits, Class1 Division 2	HYDROGEN (Group A & B):	
	• Max. loop inductance	6 mH
	• Max. loop capacitance	0.25 µF
	NON-HYDROGEN (Group C & D):	
	• Max. loop inductance	20 mH
	• Max. loop capacitance	5 µF

TSGAS-1624

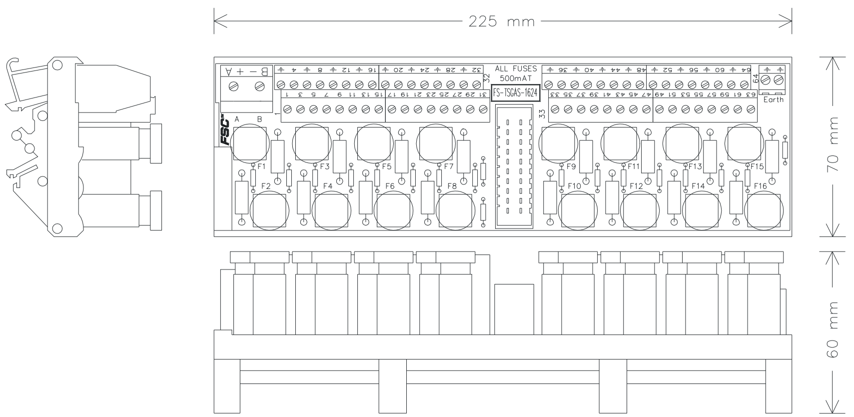
Safe gas / flame detector input FTA (0-20 mA, 16 channels)

Description

The field termination assembly module TSGAS-1624 is the interface between gas/flame detectors in the field and the safe high-density analog input module SAI-1620m in Safety Manager. The TSGAS-1624 module has sixteen analog input channels which may be used for both safety-related and non-safety-related applications. The TSGAS-1624 module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply, ground and field wiring.

Figure 331 Mechanical layout



Main functions

The TSGAS-1624 module has three main functions:

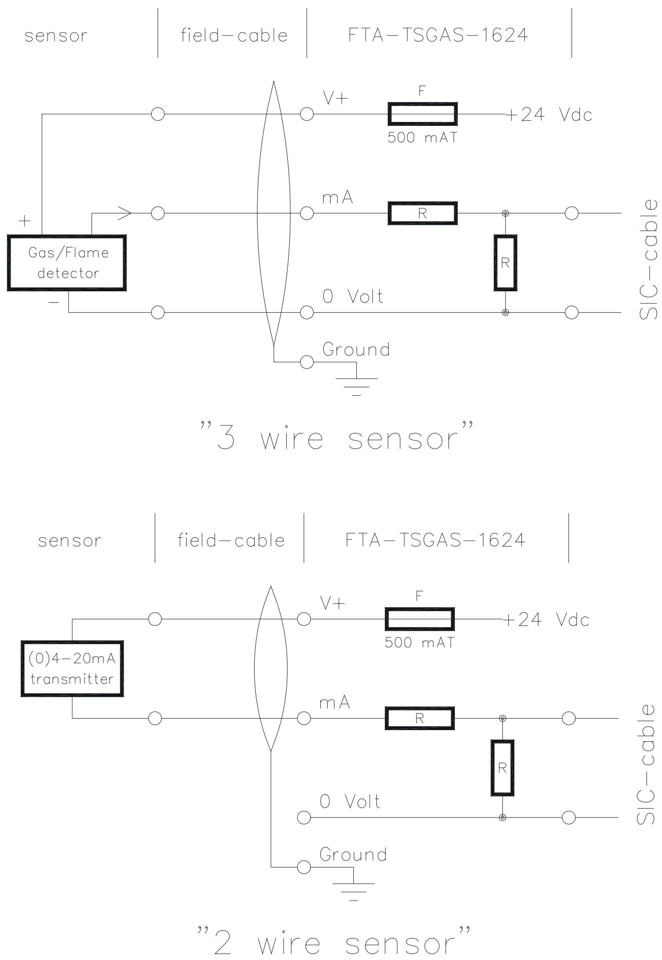
- Linear direct conversion of 0(4)—20 mA DC field signals to the signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter (500 mAT fused)
- Enable monitoring of the external power connected to the TSGAS-1624 module

Linear direct conversion

The input circuit of each channel consists of a high-precision resistor which converts the input current (0—20 mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is fused (500 mAT) per channel. Each analog input has its own terminal for the field cable shield.

Figure 332 on page 553 shows the schematic diagram for connecting a transmitter (active and passive).

Figure 332 Schematic diagram for connecting a transmitter



External power

External power can be connected to the TSGAS-1624 module via the power screw terminal pair marked ‘A’ and ‘B’.

Note

The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager software can monitor the external power voltage via the safe high-density analog input module SAI-1620m.

Applications

For details on applications and connection options for the TSGAS-1624 module, see section “SICC-0001/Lx” on page 715.

Connections

External power and ground

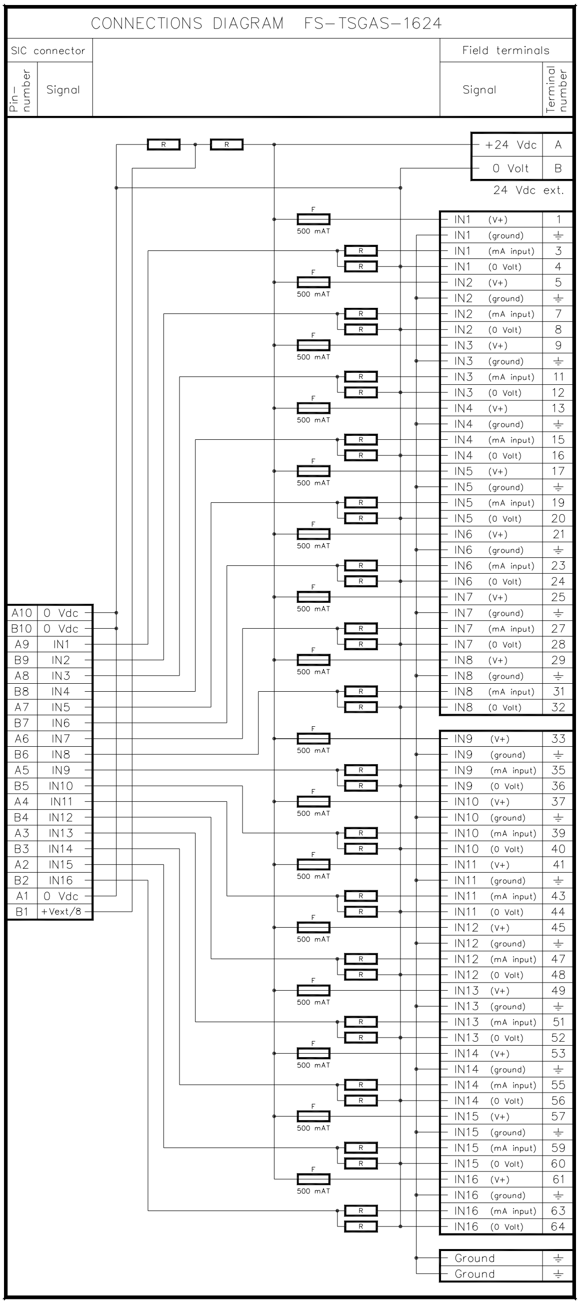
The external supply voltage (Vext) and ground are connected to the following screw terminals (marked ‘A’ and ‘B’ and ‘⏚’ on the FTA):

Screw terminal	Function
A	24 Vdc Vext
B	0 Vdc Vext
⏚	Ground connection
⏚	Ground connection (1 ground wire is enough)

Connections diagram

The TSGAS-1624 module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64. The connections diagram of the TSGAS-1624 module is as follows:

Figure 333 Connections diagram



Technical data

The TSGAS-1624 module has the following specifications:

General	Type numbers[1] :	FS-TSGAS-1624
		FC-TSGAS-1624
	Approvals:	CE, TUV, UL, CSA, FM
Input	Number of input channels:	16 (with common 0 V)
	Power requirements:	24 Vdc external, 3 mA (without field loads)
	Input current:	0—25 mA
	Input resistance:	500 Ω (± 5%)
Output	To SAI-1620m module:	
	• Output voltage	0—4 Vdc
	• Accuracy	0.1%
Fuses	Rating:	500 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	225 × 70 × 60 mm (L × W × H) 8.86 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	226 mm (8.90 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
	Power screw terminals (A, B):	
	• Max. wire diameter	16 mm² (AWG 8)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	1.2 Nm (0.88 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSGASH-1624

Safe gas/flame detector input FTA with HART interface (0-20 mA, 16 channels)

Description

The field termination assembly module TSGASH-1624 is the interface between gas/flame detectors with HART interface in the field and the safe high-density analog input module SAI-1620m in Safety Manager.

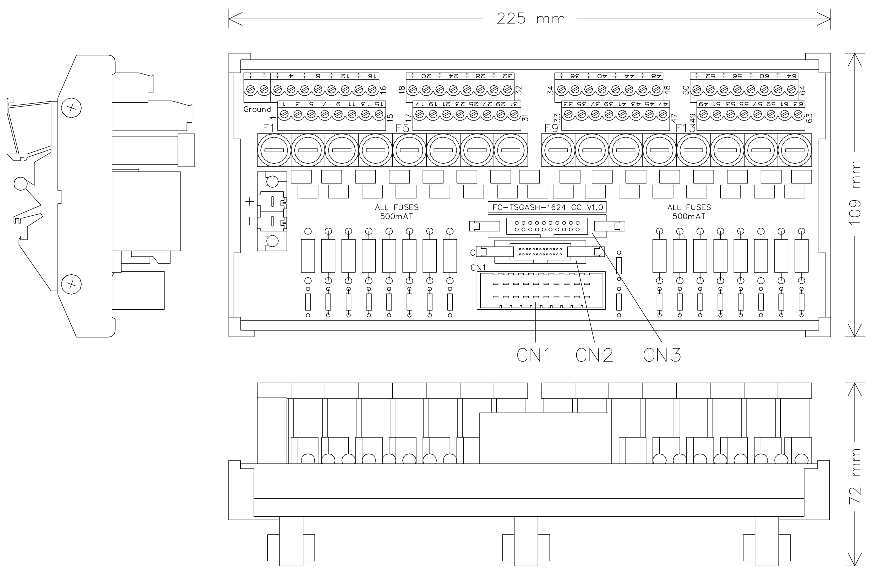
The TSGASH-1624 module has sixteen analog input channels which may be used for both safety-related and non-safety-related applications.

The TSGASH-1624 module provides HART interface on all 16 channels. The module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of ground and field wiring.

The FTA module has a 2-pole power connector to connect the module with a 24Vdc power source.

Figure 334 Mechanical layout



Main functions

The TSGASH-1624 module has the following functions:

- Linear direct conversion of 0(4)-20mA DC field signals to signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter (500mAT fused)
- Enable connection to HART multiplex units of MTL or Pepperl+Fuchs (P+F)
- Enable monitoring of the external power connected to the TSGASH-1624 module.

Linear direct conversion

The input circuit of each channel consists of a high-precision resistor which converts the input current (0-20mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is fused (500mAT) per channel.

Each analog input has its own terminal for the field cable shield.

Figure 335 on page 559 shows the schematic diagram for connecting a transmitter (active or passive).

HART interface

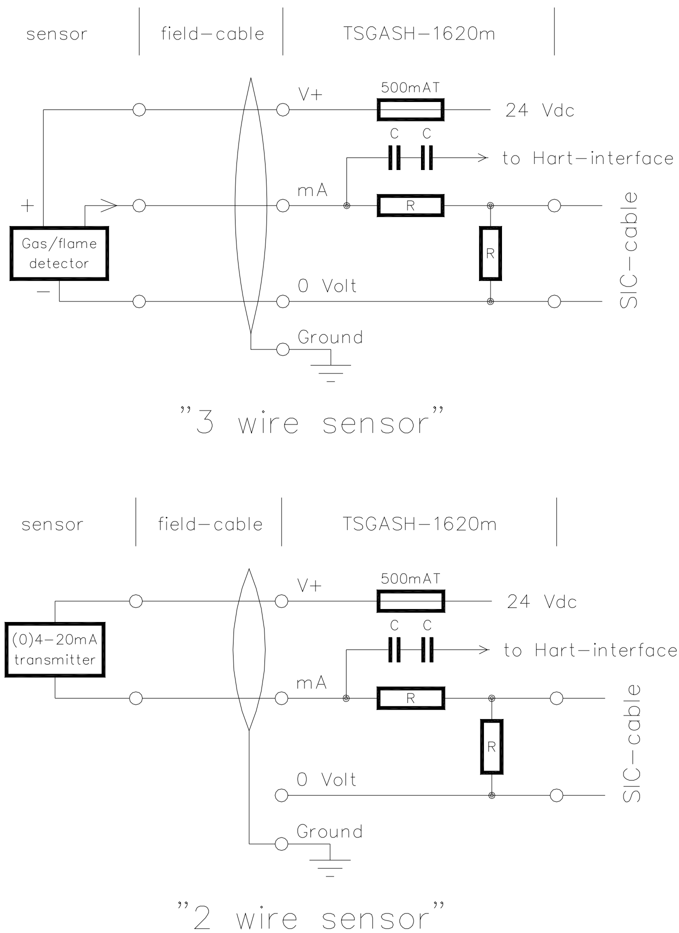
The TSGASH-1624 module provides interfaces to HART multiplex units from MTL and Pepperl+Fuchs (P+F). Dedicated connectors are installed on the FTA to enable the use of the standard cables from these suppliers.

The following equipment can be connected:

	MTL Solution	P+F solution
Multiplexer unit	MTL4842	KFD0-HMS-16 or KFD2-HMM-16
Cable	MTL FLAT20-2.2	K-MH26
Connector on FTA[1]	CN3	CN2

1 See Figure 334 on page 557

Figure 335 Schematic diagram for connecting a transmitter



External power

A 24 Vdc power distribution cable (see data sheet "PDC-MB24-x" on page 812 for details) can be used to connect the main bus bar with the power connector on the TSGASH-1624 module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BL 5.08/SN OR connector is used.

Note

The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager software can monitor the external power voltage via the safe high-density analog input module SAI-1620m.

Applications

For applications and connection options for the TSGASH-1624 module, see section “SICC-0001/Lx” on page 715.

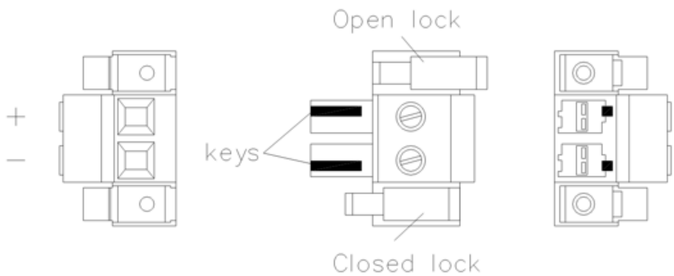
Connections

External power and ground

Figure 336 on page 560 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked '+' is pin 1: connected to +24Vdc bus bar.
- The pin marked '-' is pin 2: connected to the 0Vdc bus bar.

Figure 336 Power input connector (Weidmuller BVZ 7.62/02F SW) top, side and bottom view



The two (orange) locking slides of the cable-connector in Figure 336 on page 560 keep the cable-connector locked when inserted into the power connector.

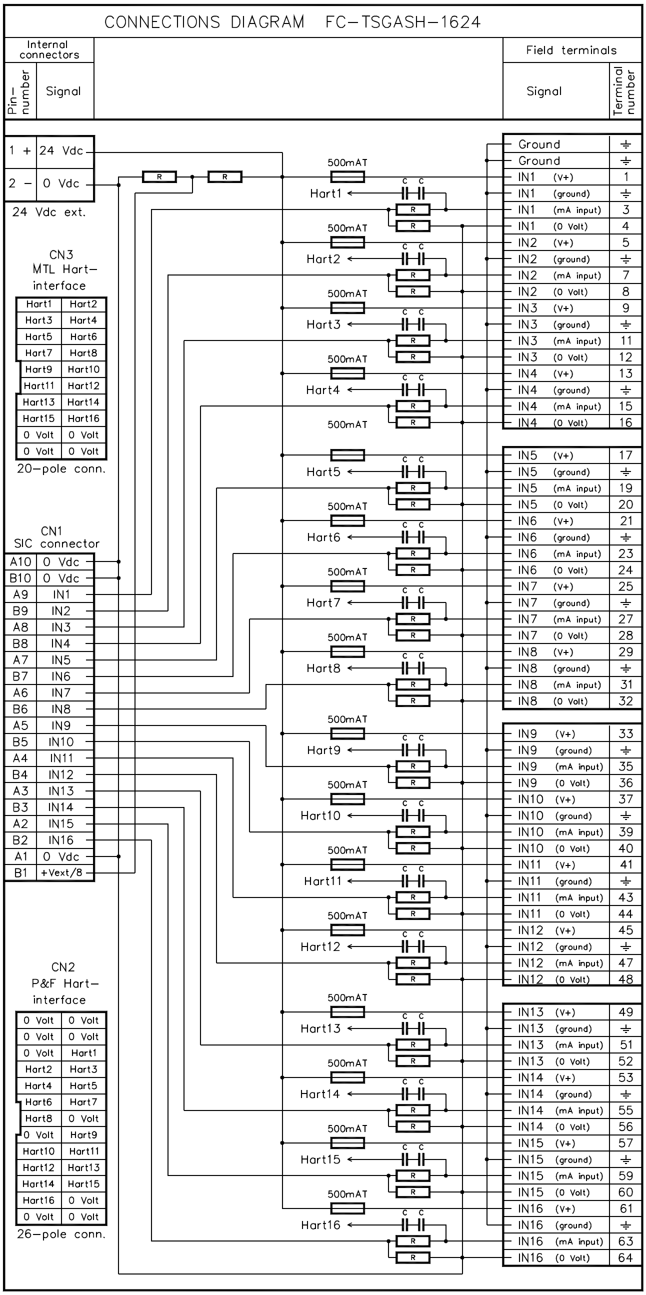
The (two) Ground screw connections on the top left side in Figure 334 on page 557 are used to connect Ground with the "ground" pins of the channels. One ground wire is enough.

Connections diagram

The TSGASH-1624 module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

The connections diagram of the TSGASH-1624 module is as follows:

Figure 337 Connections diagram



Technical data

The TSGASH-1624 module has the following specifications:

General	Type numbers[1] :	FC-TSGASH-1624 CC V1.0
	Approvals:	CE; TUV, UL, CSA pending
Input	Number of input channels:	16 (with common 0 V)
	Power requirements:	24 Vdc external, 2.5mA (without field loads)
	Input current:	0—25 mA
	Input resistance:	500 Ω (± 5%)
Output	To SAI-1620m module:	
	• Output voltage	0—4 Vdc
	• Accuracy	0.1%
	To HART multiplexer unit:	
	• Output voltage	Max. 11 V peak-peak
	• Series impedance	> 2μF
Fuses	Rating:	500 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	225 × 109× 60 mm (L × W × H) 8.86 × 4.29 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	226 mm (8.90 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
	Power connector:	
	• model	2 pole header with keying
	• Make and type	Weidmuller: BVZ 7.62/02F SW (con.) Weidmuller: KO BV/SV7.62 (keys)
	• Strip length	8 mm (0.28 in)
	• connectable conductors	0.5—6 mm² (AWG20—AWG10)

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSGASH-1624P

Safe gas/flame detector input FTA with HART interface (0-20 mA, 16 channels)

Description

The field termination assembly module TSGASH-1624P is the interface between gas/flame detectors with HART interface in the field and the safe high-density analog input module SAI-1620m in Safety Manager.

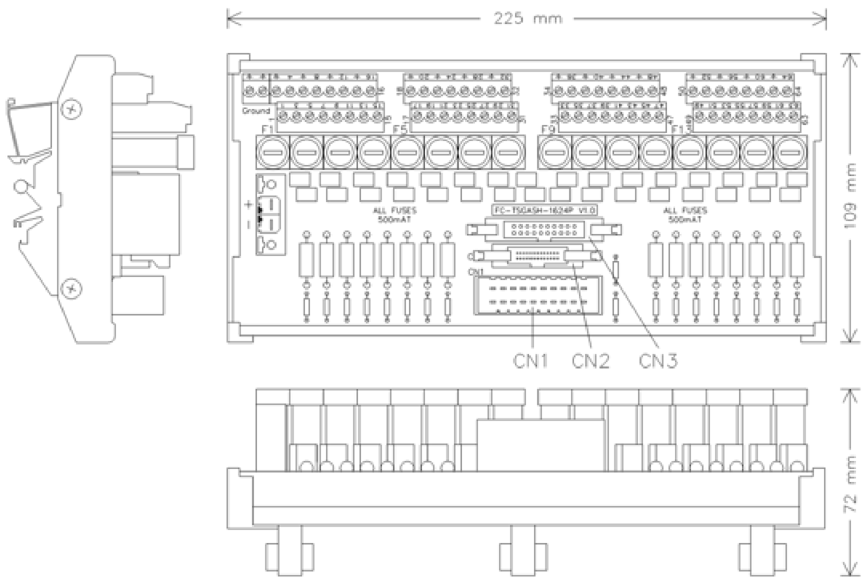
The TSGASH-1624P module has sixteen analog input channels which may be used for both safety-related and non-safety-related applications.

The TSGASH-1624P module provides HART interface on all 16 channels. The module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of ground and field wiring.

The FTA module has a 2-pole power connector to connect the module with a 24Vdc power source.

Figure 338 Mechanical layout



Main functions

The TSGASH-1624P module has the following functions:

- Linear direct conversion of 0(4)-20mA DC field signals to signal levels of the safe high-density analog input module SAI-1620m
- Power supply distribution to each transmitter (500mAT fused)
- Enable connection to HART multiplex units of MTL or Pepperl+Fuchs (P+F)
- Enable monitoring of the external power connected to the TSGASH-1624P module.

Linear direct conversion

The input circuit of each channel consists of a high-precision resistor which converts the input current (0-20mA) to the input voltage for the high-density analog input module SAI-1620m. The power to the analog transmitter is fused (500mAT) per channel.

Each analog input has its own terminal for the field cable shield.

Figure 339 on page 565 shows the schematic diagram for connecting a transmitter (active or passive).

HART interface

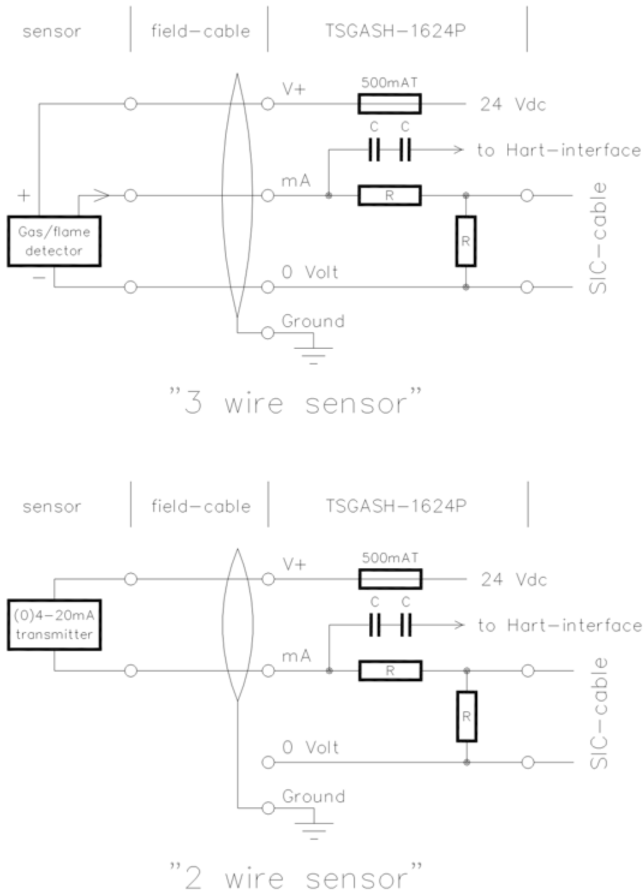
The TSGASH-1624P module provides interfaces to HART multiplex units from MTL and Pepperl+Fuchs (P+F). Dedicated connectors are installed on the FTA to enable the use of the standard cables from these suppliers.

The following equipment can be connected:

	MTL Solution	P+F solution
Multiplexer unit	MTL4842	KFD0-HMS-16 or KFD2-HMM-16
Cable	MTL FLAT20-2.2	K-MH26
Connector on FTA[1]	CN3	CN2

1 See Figure 338 on page 563

Figure 339 Schematic diagram for connecting a transmitter



External power

A 24 Vdc power distribution cable (see data sheet "PDC-MB24-y" on page 814 for details) can be used to connect the main bus bar with the power connector on the TSGASH-1624P module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

Note

The 0 V connection of the external power is directly connected to the common 0 V of all sixteen analog inputs.

The Safety Manager software can monitor the external power voltage via the safe high-density analog input module SAI-1620m.

Applications

For applications and connection options for the TSGASH-1624P module, see section "SICC-0001/Lx" on page 715.

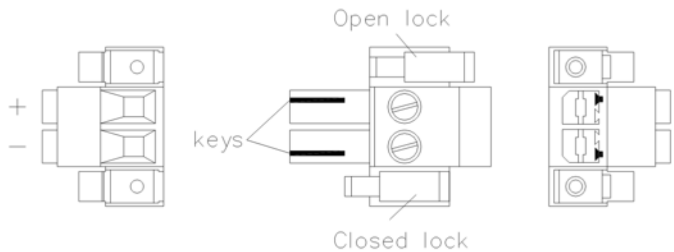
Connections

External power and ground

Figure 340 on page 566 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked '+' is pin 1: connected to +24Vdc bus bar.
- The pin marked '-' is pin 2: connected to the 0Vdc bus bar.

Figure 340 Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view



The two (red) locking slides of the cable-connector in Figure 340 on page 566 keep the cable-connector locked when inserted into the power connector.

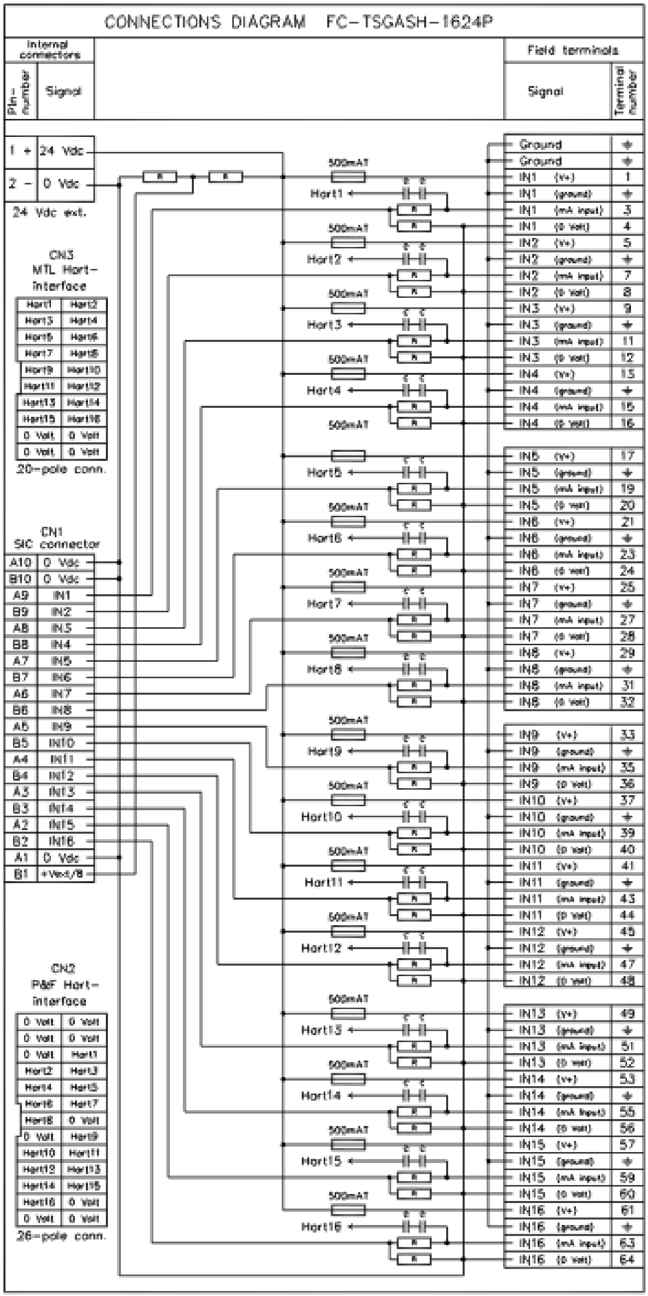
The (two) Ground screw connections on the top left side in Figure 338 on page 563 are used to connect Ground with the "ground" pins of the channels. One ground wire is enough.

Connections diagram

The TSGASH-1624P module has sixteen groups (= sixteen channels) of four screw terminals to provide optimum connection of field wiring, with a ground terminal per channel for screening of analog input cables. The screw terminals are numbered 1 to 64.

The connections diagram of the TSGASH-1624P module is as follows:

Figure 341 Connections diagram



Technical data

The TSGASH-1624P module has the following specifications:

General	Type numbers[1] :	FC-TSGASH-1624P V1.0
	Approvals:	CE; TUV, UL, CSA pending
Input	Number of input channels:	16 (with common 0 V)
	Power requirements:	24 Vdc external, 2.5mA (without field loads)
	Input current:	0—25 mA
	Input resistance:	500 Ω (± 5%)
Output	To SAI-1620m module:	
	• Output voltage	0—4 Vdc
	• Accuracy	0.1%
	To HART multiplexer unit:	
	• Output voltage	Max. 11 V peak-peak
	• Series impedance	> 2µF
Fuses	Rating:	500 mAT (slow-acting)
	Dimensions:	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	225 × 109× 60 mm (L × W × H) 8.86 × 4.29 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	226 mm (8.90 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm^2 (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
	Power connector:	
	• model	2 pole header with keying
	• Make and type	Weidmuller: BVZ 7.62HP/02/180F SN (con.) Weidmuller: BV/SV7.62HP KO (keys)
	• Strip length	8 mm (0.28 in)
	• connectable conductors	0.5—6 mm^2 (AWG20—AWG10)

1 FC-type modules are conformal coated modules.

TSFIRE-1624

Safe fire detector input FTA with line monitoring (24 Vdc, 16 channels)

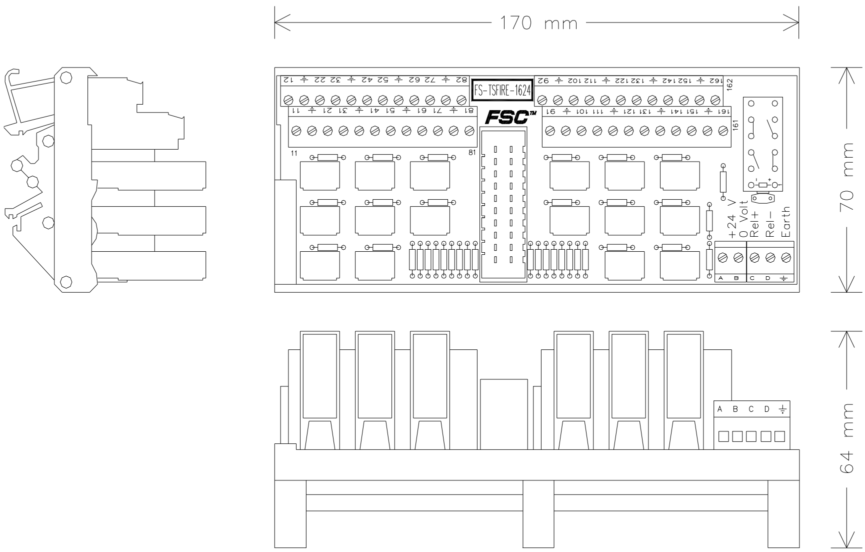
Description

Field termination assembly module TSFIRE-1624 is the interface between (digital) fire detectors and the safe high-density analog input module SAI-1620m in Safety Manager. It may be used for installations in, and interfacing signals to Class I, Division 2 Hazardous Locations.

The TSFIRE-1624 module has sixteen digital detector input channels which may be used for both safety-related and non-safety-related applications. The TSFIRE-1624 module uses a SICC-0001/Lx system interconnection cable to transfer the 16 input signals to a (redundant pair of) SAI-1620m module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connection of power supply and field wiring.

Figure 342 Mechanical layout



Main functions

The TSFIRE-1624 module has three main functions:

- Power supply to each detector with voltage-current limitation in compliance with Hazardous Area Class I Division 2
- Fire detection input function
- Global reset of the connected sensors

Power supply detector

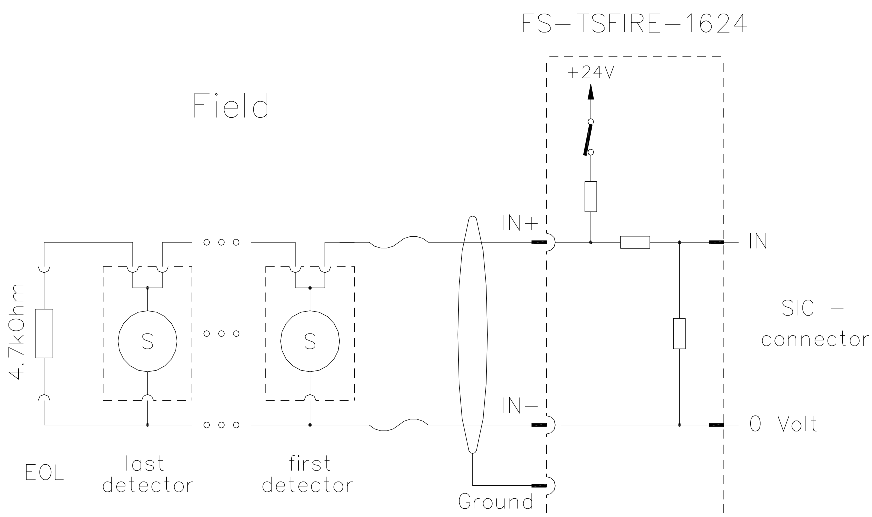
The TSFIRE-1624 module requires an external 24 Vdc power supply. This provides a field signal with open voltage of approximately 24 Vdc and a short-circuit current of approximately 35 mA. Normal operating voltage (with a 4.7 kΩ EOL resistor) is approximately 20.5 Volts.

Fire detector input

The TSFIRE-1624 module converts an input for 24 V fire detectors to levels suitable for the SAI-1620m module.

Figure 343 on page 570 shows the schematic diagram for the connection of fire detectors or manual call points.

Figure 343 Typical schematic diagram for TSFIRE-1624 input



Global reset

The relay on the TSFIRE-1624 module enables a reset of all connected detectors by removing the supply voltage to the field. The relay is normally de-energized (energized = reset detectors). The Global Reset function is non-safety related.

Applications

For details on applications and connection options for the TSFIRE-1624 module, see section “SICC-0001/Lx” on page 715.

Connections

Common signals

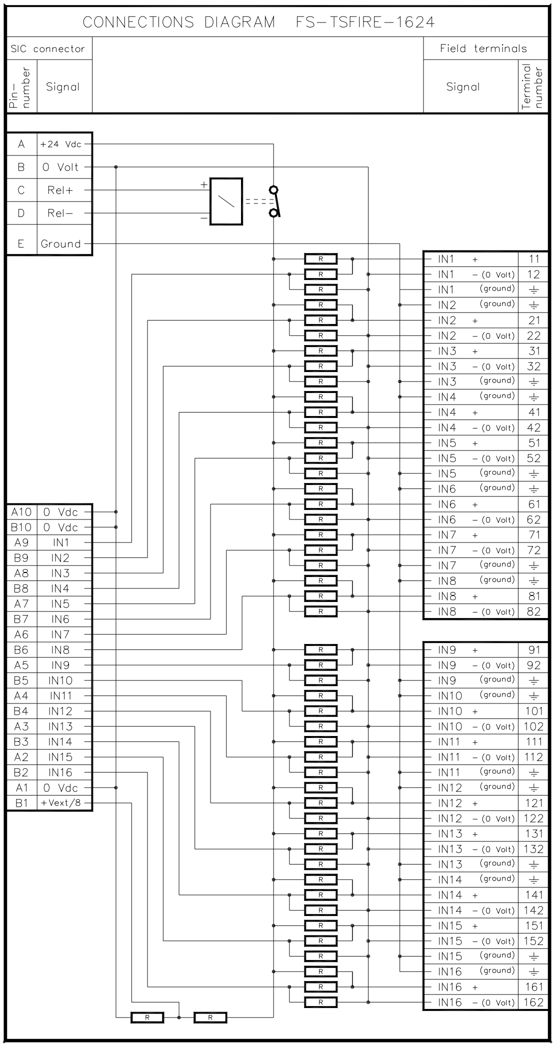
The connections for common signals are as follows:

Screw terminal	Function
A	+24 Vdc Vext
B	0 Vdc Vext
C	Rel+
D	Rel–
E	Ground

Connections diagram

The TSFIRE-1624 module has 48 screw terminals for connection of field wiring. The connections diagram of the TSFIRE-1624 module is as follows:

Figure 344 Connections diagram



Technical data

The TSFIRE-1624 module has the following specifications:

General	Type numbers[1 2]:	FS-TSFIRE-1624 V1.1
		FC-TSFIRE-1624 V1.1
	Approvals	CE, TUV, UL, CSA, FM
Pwr requirements 24 Vdc ext.	Voltage	24 Vdc +25% / –15%
	Current • With EOL resistors • No load	Max. 570 mA (at 24 Vdc ext.) • Typ. 70mA (at 24 Vdc ext.) • Typ. 11mA (at 24 Vdc ext.)
Input	Number of channels	16
	Input Voltage • With EOL resistor (4k7) • No load	 • Typ. 20.5 Vdc (at 24 Vdc ext.) • Typ. 23.5 Vdc (at 24 Vdc ext.)
	Channel resistance	680 Ω +/–5%
	Shorted current	35 mA (at 24 Vdc ext.)
Relay	Relay voltage	17 – 39 Vdc
	Current	Typ. 8.5 mA at 24 Vdc
Termination	Screw terminals	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
Field signal specifications	Field wire resistance	< 100 Ω
	End-of-line (EOL) resistor	For example 4k7, ± 5% (0.25 W) (see F&G Application Manual, PM.MAN.8163)
	HYDROGEN (Group A & B)	
	• Max. loop inductance	60 mH
	• Max. loop capacitance	0.3 µF
	NON-HYDROGEN (Group C & D)	
	• Max. loop inductance	230 mH
	• Max. loop capacitance	7 µF

Physical	Module dimensions	170 × 70 × 64 mm (L × W × H) 6.72 × 2.76 × 2.52 in (L × W × H)
	DIN EN rails	TS32 / TS35 × 7.5
	Used rail length	171 mm (6.73 in)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved PCB design; these versions of the module are equipped with rectangular white resistors.
For earlier versions of the module the +Vext/8 read back (pin B1) is connected with the +24Vdc (screw terminal A).

TSDO-0824

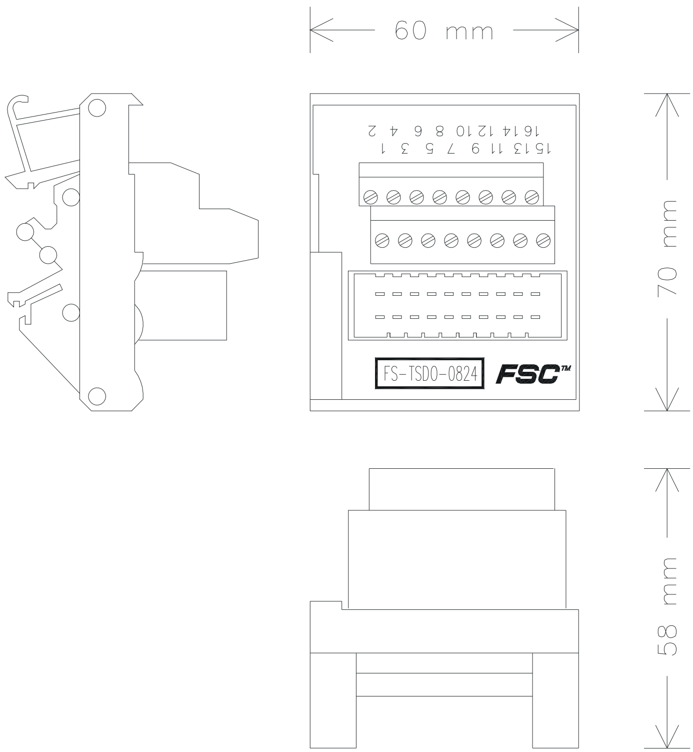
Safe digital output FTA (24 Vdc, 8 channels)

Description

Field termination assembly module TSDO-0824 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The eight channels of a (redundant pair of) SDO-0824 module(s) can be connected to the TSDO-0824 module via the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 345 Mechanical layout



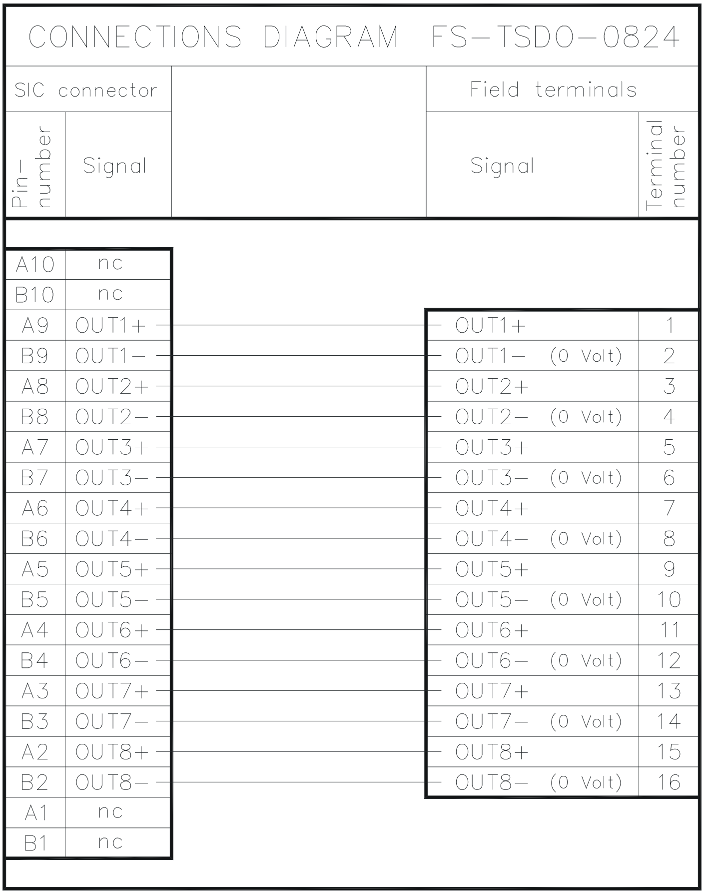
Applications

For details on applications and connection options for the TSDO-0824 module, see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSDO-0824 module:

Figure 346 Connections diagram



Technical data

The TSDO-0824 module has the following specifications:

General	Type numbers[1] :	FS-TSDO-0824
		FC-TSDO-0824
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	8
	Maximum voltage:	36 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	1.5 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	60 × 70 × 58 mm (L × W × H) 2.36 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

TSDO-0824C

Conformal coated safe digital output FTA, current limited (24 Vdc, 8 channels)

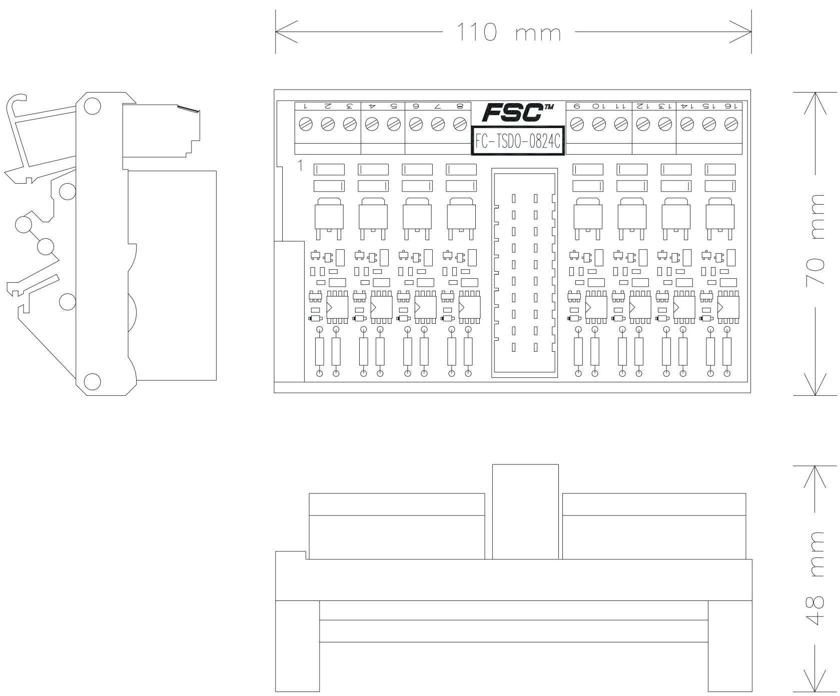
Description

Field termination assembly module TSDO-0824C is the interface between safe digital output module SDO-0824 with a system interconnection cable (SICC-0001/Lx) and the external field wiring (screw terminals). It can be used for interfacing to Class I, Division 2 Hazardous locations.

The TSDO-0824C provides eight current limited safe digital outputs to the field. Each output is capable of supplying 110 mA (= 2.5 Watt at 24 Vdc).

The FTA module is coated conform the requirements for type A coatings given in IEC 60664-3 (the values for POLLUTION DEGREE 1 apply), has a universal snap-in provision for standard DIN EN rails, and screw terminals for the field wiring.

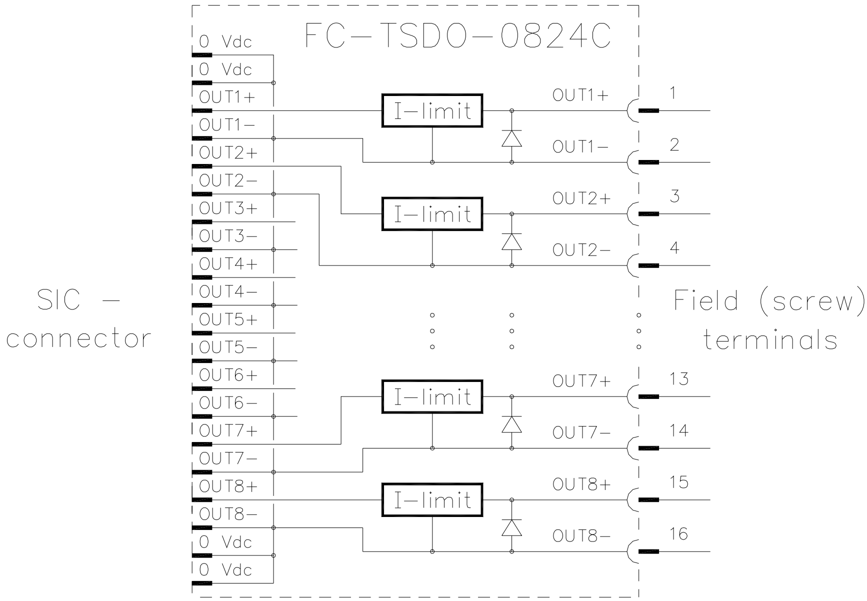
Figure 347 Mechanical layout



Applications

For details on applications and connection options for the TSDO-0824C module, see section “SICC-0001/Lx” on page 715.

Figure 348 Schematic diagram



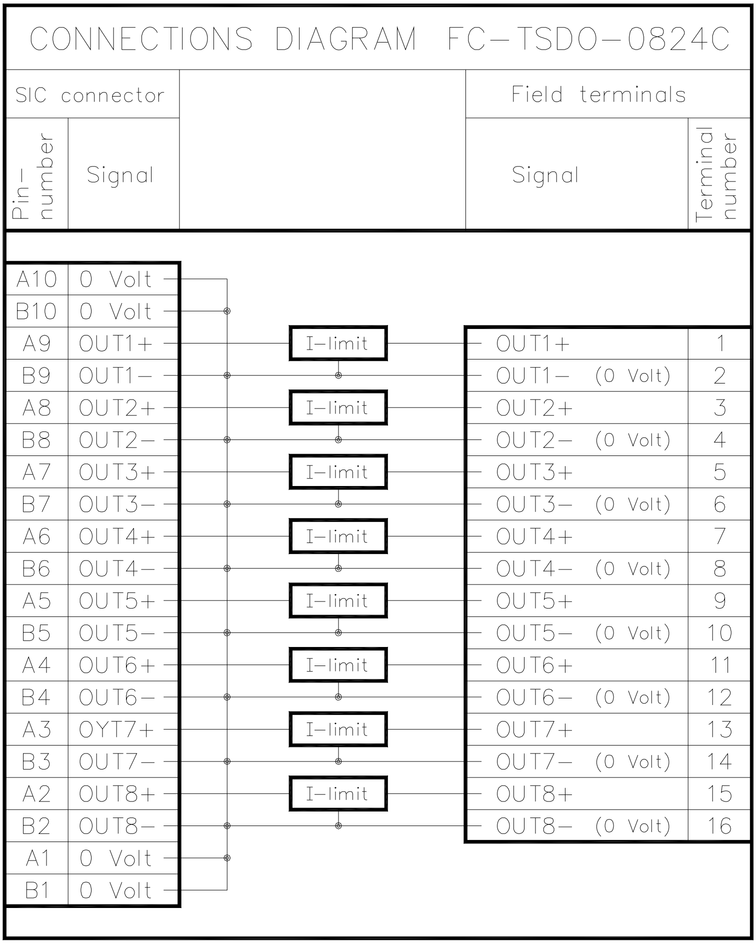
Main function

The TSDO-0824C can energize loads (for example solenoids or LEDs) with voltage-current limitation in compliance with Hazardous Class I, Division 2. The external output-signal (OUT+) is electronically current-limited.

Connections

The connections diagram of the TSDO-0824C:

Figure 349 Connections diagram



Technical data

The TSDO-0824C has the following specifications:

General	Type number[1]:	FC-TSDO-0824C
	Approvals	CE, TUV, UL, CSA, FM
	Environmental shielding	Conformal coating
Power	Number of channels:	8
	Maximum voltage:	36 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Power requirements:	5 mA per channel (plus output load)
Output	Output current limit:	> 110 mA
	Max. output load:	2.5 Watt (at 24 Vdc)
	Voltage drop:	< 1.5 Vdc at 110 mA
	Off current:	< 0.1 mA
Physical	Module dimensions:	110 × 70 × 48 mm (L × W × H) 4.32 × 2.76 × 1.89 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	111 mm (4.36 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)
Field signal specifications	HYDROGEN (Group A & B)	
	• Max. loop inductance	3.0 mH
	• Max. loop capacitance	0.2 µF
	NON-HYDROGEN (Group C & D)	
	• Max. loop inductance	12 mH
	• Max. loop capacitance	5 µF

1 FC-type modules are conformal coated modules.

TDOL-0724

Line-monitored relay contact digital output (7 channels, 24Vdc)

Description

The field termination assembly module TDOL-0724 is an interface to field loads that require 24Vdc line-monitored digital outputs.

The TDOL-0724 has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads upto 50Watt.

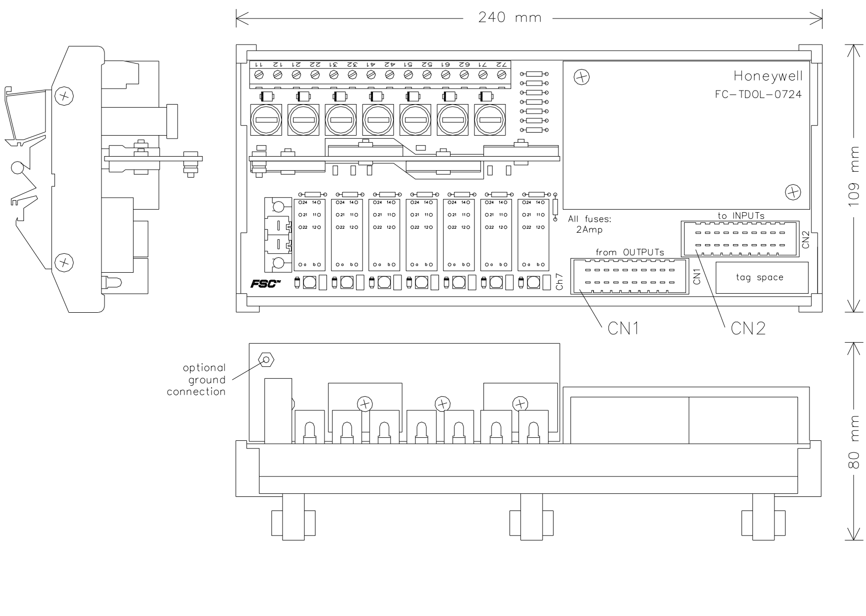
Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either **energized** or **de-energized**.

For these line-monitoring diagnostics the TDOL-0724 operates in combination with standard DI and DO modules of Safety Manager (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-0724 has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and a (2-pole) power connector for the common supply connection.

Figure 350 Mechanical layout



Main functions and usage

The TDOL-0724 is connected to a (non-redundant or redundant) SDO-0824 output module and a (non-redundant or redundant) SDI-1624 input module via system interconnection cables (SICs).

- A fused relay contact connects the common supply voltage (24Vdc) with a field terminal. The 7 output relays are controlled by channel 1 to 7 of the SDO-0824. A LED indicates the state of its output relay.
- Each output channel has line-monitoring circuits. The line-monitoring circuits are controlled by channel 8 of the SDO-0824 and are wired to channel 1 to 15 of the SDI-1624.
- Special application logic drives the outputs and processes the line monitoring results.

Schematic diagram of a channel

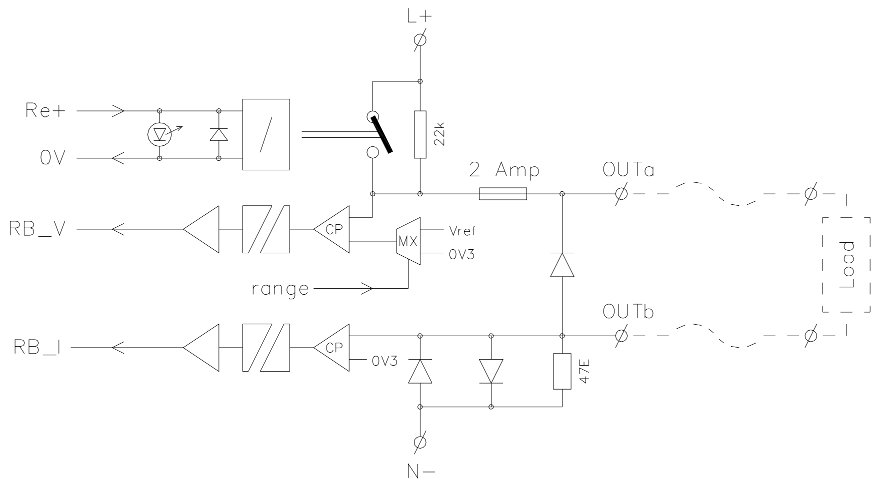
Figure 351 on page 584 shows a schematic diagram of a channel. Each channel consists of:

- one relay with indicator LED
- a fused (2 AT) contact output
- a current injection resistor (22kΩ)
- a voltage readback circuit (with two ranges)
- a current sense connection and a current readback circuit

The common part of the module (see Figure 356 on page 589) consists of:

- a DC/DC converter to supply the voltage- and current- readback circuits.
- a supply voltage monitor (generating the `RB_PWR` signal)
- an opto-coupler to transfer the range switch command from the Controller 24Vdc side to the field 24Vdc side.

Figure 351 Schematic diagram of a channel



Lead breakage detection.

Lead breakage in a channel is detected if:

- The channel is `off` and the 22kΩ channel resistor (see Figure 351 on page 584) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is `on` and the current readback (RB_I) threshold (approx. `0.3V`) is *not* met.

Note:

A blown channel fuse will be indicated as lead breakage of that channel.

To prevent lead breakage indication on a spare channel, the `USED` input of that channel (an input of the channel application function block) must be `low`. For details see “Special application logic” on page 585.

Short circuit detection

Short circuit in a channel is detected if:

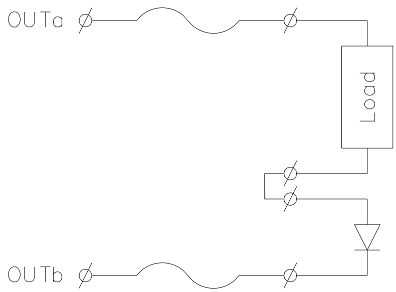
- The channel is `off` and the 22kΩ channel resistor (see Figure 351 on page 584) is not able to create a field voltage drop higher than the `low` threshold value (approx. `0.3V`).
- The channel is `on`. This will blow the channel fuse and will be indicated as lead breakage.

Field loads with a resistance below 400Ω

Field loads with a resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional diode can be wired in series with the load as shown in Figure 352 on page 585. Behind this diode the short circuit detection is "blind", so this diode should be placed as close to the load as possible.

Figure 352 Additional diode for loads < 400Ω



Note:

The additional diode for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7Amp, or of type 1N5404 (or equivalent) for loads up to 2 Amp.

Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

"Common function blocks" on page 585 and "Channel function blocks" on page 587 explain the function of this special application logic.

Note:

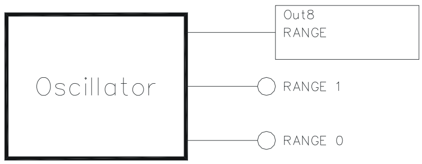
Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

Common function blocks

Figure 353 on page 586 and Figure 354 on page 586 show the schematics of the common function blocks required for the TDOL-0724.

Oscillator function block

Figure 353 Example of the oscillator function block



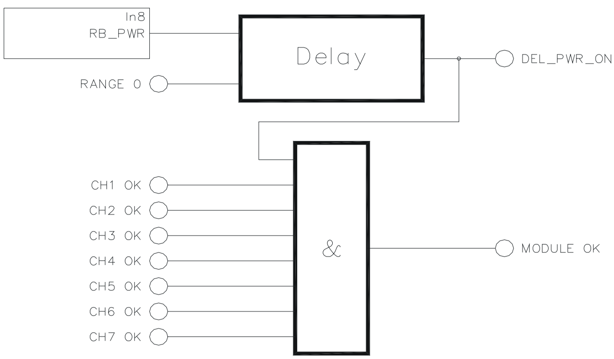
The oscillator function block may be global (one per series of TDOL-0724 FTAs in a Safety Manager).

The oscillator toggles the `RANGE` input of the voltage readback circuits on each TDOL-0724 and controls the latches in each channel function block.

This allows each channel function block to monitor the line for both energized *and* de-energized channels.

Delay and OK function block

Figure 354 Example of the delay and OK function block



The delay and OK function block is common per TDOL-0724.

- The Delay logic monitors the presence of 24V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the `CHx OK` signals of the seven channels function blocks of the TDOL-0724, as indicated in Figure 355 on page 587.

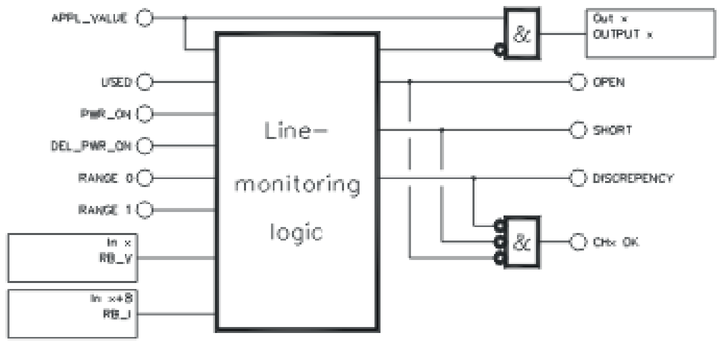
  If all channels are OK, the `MODULE OK` output is `high`.

Channel function blocks

Figure 355 on page 587 shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-0724 FTA.

Figure 355 Example of a channel function block



A standard channel function block as shown in Figure 355 on page 587 has:

- an application value input APPL_VALUE
- a USED input to prevent lead breakage (OPEN) indications on unused channels.
- four inputs that must be linked to the common function blocks (for details see "Common function blocks" on page 585)
- one input for the voltage readback result RB_V of each channel (IN 1 thru 7)
- one input for the current readback result RB_I of each channel (IN 9 thru 15)
- one output for the output relay OUT of each channel (DO channel 1 thru 7)
- a SHORT output that indicates a short-circuit on the field wires
  (a SHORT detection also blocks the energization of the output relay)
- an OPEN output that indicated lead-breakage on the field wires (or output fuse blown)
- a DISCREPENCY output that indicates:
  - Field output is on while relay not energized or
  - Field output is low, while relay energized.
- a CHx OK output if no (line monitoring) errors are detected

Channel assignment:

When connected to the TDOL-0724 the IO channels of the SDO-0824 and the SDI-1624 are assigned as follows:

Field channel TDOL-0724	Controlling outputs SDO-0824[1]	line monitoring inputs SDI-1624[2]	
		RB_V	RB_I
Channel 1	Output 1	Input 1	Input 9
Channel 2	Output 2	Input 2	Input 10
Channel 3	Output 3	Input 3	Input 11
Channel 4	Output 4	Input 4	Input 12
Channel 5	Output 5	Input 5	Input 13
Channel 6	Output 6	Input 6	Input 14
Channel 7	Output 7	Input 7	Input 15

1 Channel 8 is assigned to the voltage range switcher (`RANGE`) in the common function block

2 Channel 8 is assigned to the 24V power monitor (`RB_PWR`)
Channel 16 is unused.

Applications

For correct operation the TDOL-0724 must be combined with:

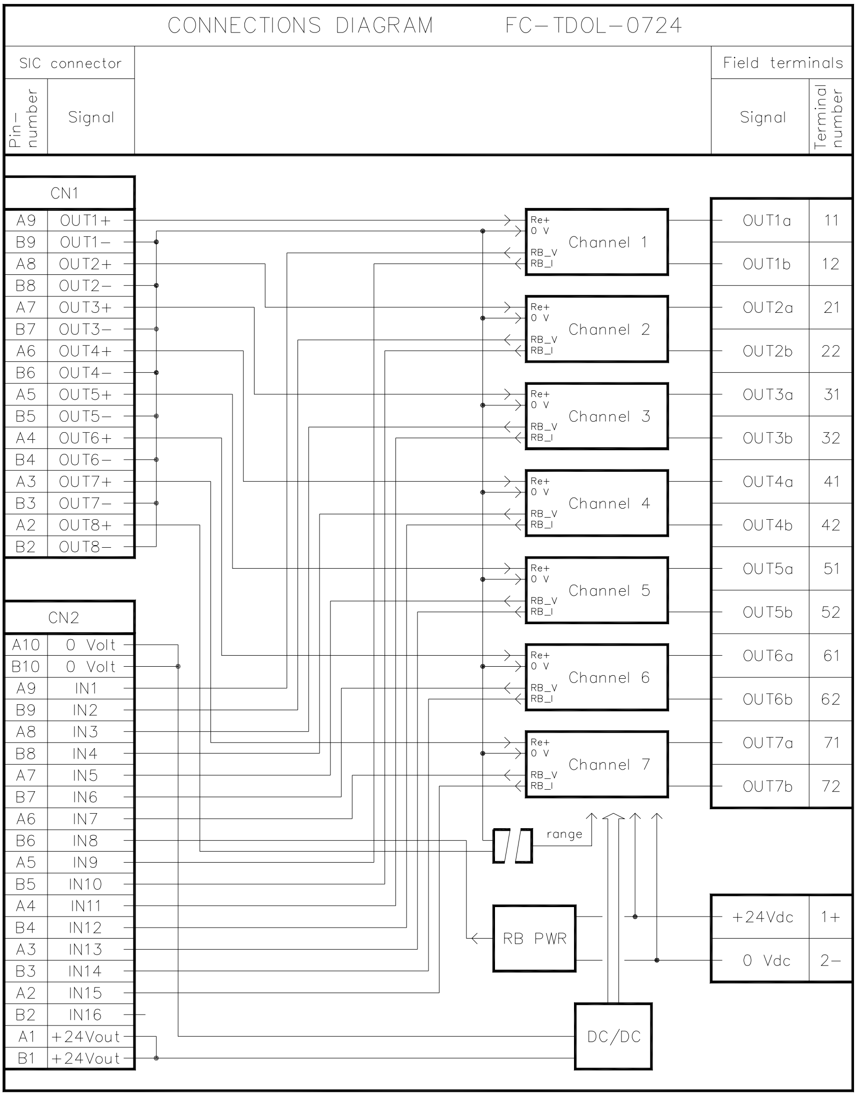
- a (redundant pair of) SDO-0824 module(s),
- a (redundant pair of) SDI-1624 module(s) and
- dedicated function blocks in the application.

For details on applications and connection options for the TDOL-0724 module, see "SICC-0001/Lx" on page 715.

Connections

The connections diagram of the TDOL-0724 module is as follows:

Figure 356 Connections diagram



SIC-connector CN1 (see Figure 350 on page 582 and Figure 356 on page 589) must be connected with the (redundant pair of) SDO-0824 module(s).

SIC-connector CN2 (see Figure 350 on page 582 and Figure 356 on page 589) must be connected with the (redundant) SDI-1624.

The TDOL-0724 has 7 pairs of terminals to connect the load.

External power

A 24 Vdc power distribution cable (see datasheet "PDC-MB24-x" on page 812 for details) can be used to connect the main busbar with the power connector on the TDOL-0724 module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62/02F SW connector is used.

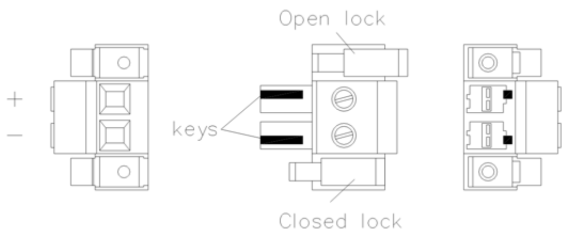
Note:

The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

Figure 357 on page 590 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked **+** is pin 1: connected to +24Vdc busbar.
- The pin marked **-** is pin 2: connected to the 0Vdc busbar.

Figure 357 Power input connector (Weidmuller BVZ 7.62/02F SW) top, side and bottom view



The two (orange) locking slides of the cable-connector in Figure 357 on page 590 keep the cable-connector locked when inserted into the power connector.

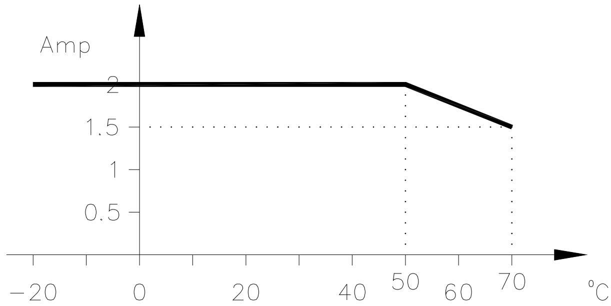
Grounding

Connect a ground wire to the (free) screw on the top left-side of the heatsink (see Figure 350 on page 582 for location) if grounding of metal parts is required.

Maximum output load

Figure 358 on page 591 shows the maximum channel load vs the ambient temperature.

Figure 358 Derating curve (channel load vs ambient temperature) for the TDOL-0724



Technical data

The TDOL-0724 module has the following specifications:

General	Type numbers[1]:	FC-TDOL-0724
	Approvals:	CE; TUV, UL, CSA pending
Outputs	Number of channels:	7
	Max. output current:	2 Amp
	Output load 24Vdc:	resistive or inductive with spark suppression diode
	Channel fuses:	5 x 20 mm (0.20 x 0.79 in) 2 Amp (slow-acting)
	Output supply voltage:	24Vdc +/- 20%
	Maximum load resistance:	2200Ω
	Leakage current to load:	approx. 1.1mA at 24V
	No load output voltage: • output OFF • output ON	 90% of output supply voltage 100% of output supply voltage
	Short-circuit detection load threshold:	$200\Omega < R_{Th} < 400\Omega$

Relay contact	Max switched power:	150 Watts
	Expected life: • electrical • mechanical	 100,000 switch operations 30,000,000 switch operations
Power consumption	Field power	
	24Vdc:	< 9mA (all channels off)
	24 Vdc (consumed via SDO-0824 and SDI-1624 IO)	
	Relais + channel 8:	approx. 200mA (out of TSDO-0824) max. 250mA at V_{max}
	Read back circuit:	< 110mA (single SDI-1624) or < 210mA (redundant SDI-1624) max. 275mA at V_{max}
Physical	Module dimensions:	240 x 109 x 80 mm (L x W x H) 9.45 x 4.29 x 3.15 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241mm (9.49 inch)
Termination	Channel screw terminals: • max wire diameter • strip length • tightening torque	 2.5 mm^2 (AWG 14) 7 mm (0.28 in) 0.5 Nm (0.37 ft-lb)
	Power connector • make and type: • strip length: • Connectable conductors:	2 pole header with keying Weidmuller: BVZ 7.62/02F SW (conn.) Weidmuller: KO BV/SV7.62 (keys) 8 mm (0.28 in) 0.5-6mm^2 (AWG 20-AWG 10)

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

TDOL-0724P

Line-monitored relay contact digital output (7 channels, 24Vdc)

Description

The field termination assembly module TDOL-0724P is an interface to field loads that require 24Vdc line-monitored digital outputs.

The TDOL-0724P has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads upto 50Watt.

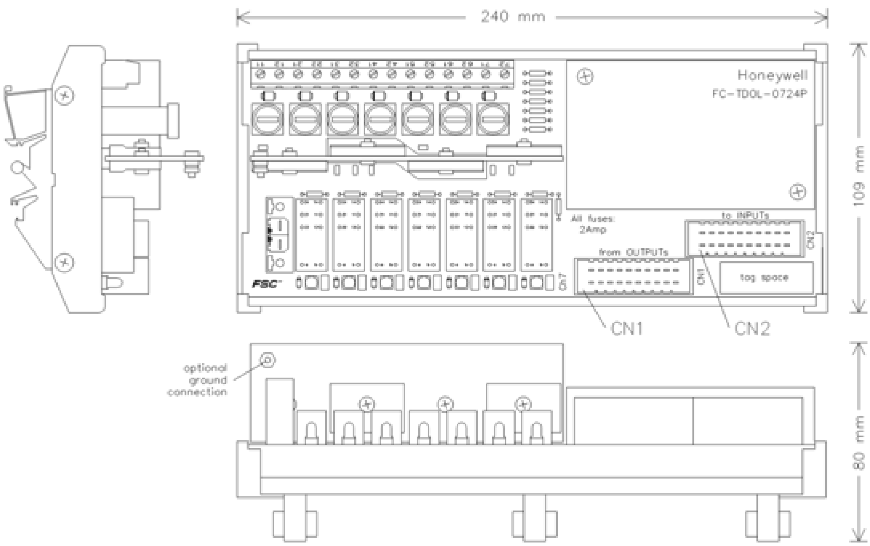
Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either **energized** or **de-energized**.

For these line-monitoring diagnostics the TDOL-0724P operates in combination with standard DI and DO modules of Safety Manager (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-0724P has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and a (2-pole) power connector for the common supply connection.

Figure 359 Mechanical layout



Main functions and usage

The TDOL-0724P is connected to a (non-redundant or redundant) SDO-0824 output module and a (non-redundant or redundant) SDI-1624 input module via system interconnection cables (SICs).

- A fused relay contact connects the common supply voltage (24Vdc) with a field terminal. The 7 output relays are controlled by channel 1 to 7 of the SDO-0824. A LED indicates the state of its output relay.
- Each output channel has line-monitoring circuits. The line-monitoring circuits are controlled by channel 8 of the SDO-0824 and are wired to channel 1 to 15 of the SDI-1624.
- Special application logic drives the outputs and processes the line monitoring results.

Schematic diagram of a channel

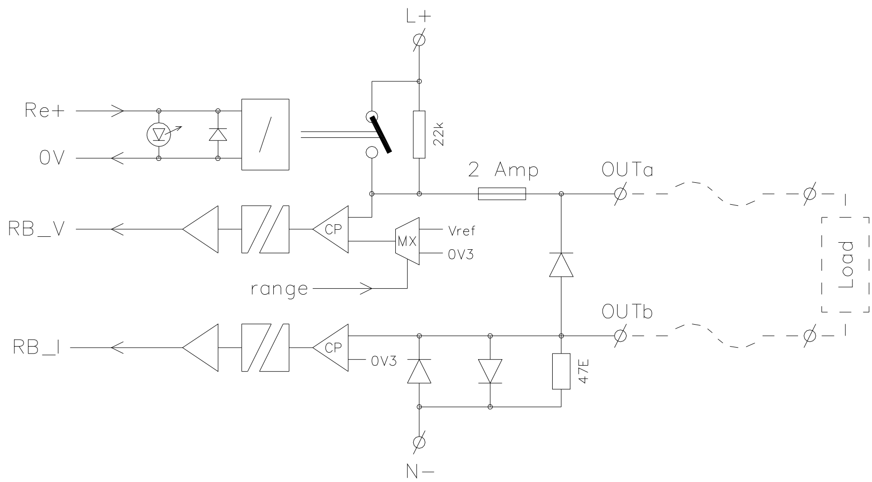
Figure 360 on page 595 shows a schematic diagram of a channel. Each channel consists of:

- one relay with indicator LED
- a fused (2 AT) contact output
- a current injection resistor (22kΩ)
- a voltage readback circuit (with two ranges)
- a current sense connection and a current readback circuit

The common part of the module (see Figure 365 on page 600) consists of:

- a DC/DC converter to supply the voltage- and current- readback circuits.
- a supply voltage monitor (generating the `RB_PWR` signal)
- an opto-coupler to transfer the range switch command from the Controller 24Vdc side to the field 24Vdc side.

Figure 360 Schematic diagram of a channel



Lead breakage detection.

Lead breakage in a channel is detected if:

- The channel is `off` and the 22kΩ channel resistor (see Figure 360 on page 595) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is `on` and the current readback (RB_I) threshold (approx. `0.3V`) is *not* met.

Note:

A blown channel fuse will be indicated as lead breakage of that channel.

To prevent lead breakage indication on a spare channel, the `USED` input of that channel (an input of the channel application function block) must be `low`. For details see “Special application logic” on page 596.

Short circuit detection

Short circuit in a channel is detected if:

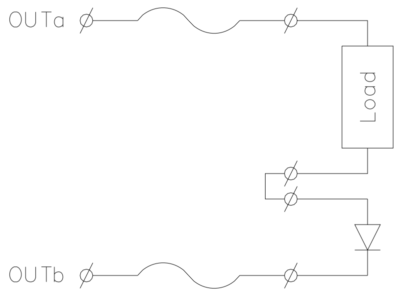
- The channel is `off` and the 22kΩ channel resistor (see Figure 360 on page 595) is not able to create a field voltage drop higher than the `low` threshold value (approx. `0.3V`).
- The channel is `on`. This will blow the channel fuse and will be indicated as lead breakage.

Field loads with a resistance below 400Ω

Field loads with a resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional diode can be wired in series with the load as shown in Figure 361 on page 596. Behind this diode the short circuit detection is “blind”, so this diode should be placed as close to the load as possible.

Figure 361 Additional diode for loads < 400Ω



Note:

The additional diode for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7Amp, or of type 1N5404 (or equivalent) for loads up to 2 Amp.

Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

“Common function blocks” on page 596 and “Channel function blocks” on page 598 explain the function of this special application logic.

Note:

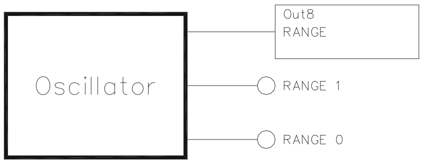
Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

Common function blocks

Figure 362 on page 597 and Figure 363 on page 597 show the schematics of the common function blocks required for the TDOL-0724P.

Oscillator function block

Figure 362 Example of the oscillator function block



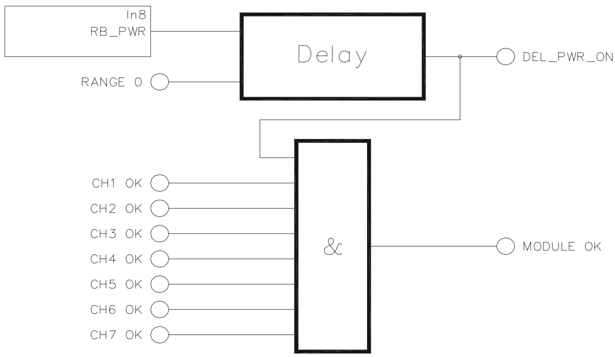
The oscillator function block may be global (one per series of TDOL-0724P FTAs in a Safety Manager).

The oscillator toggles the `RANGE` input of the voltage readback circuits on each TDOL-0724P and controls the latches in each channel function block.

This allows each channel function block to monitor the line for both energized *and* de-energized channels.

Delay and OK function block

Figure 363 Example of the delay and OK function block



The delay and OK function block is common per TDOL-0724P.

- The Delay logic monitors the presence of 24V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the `CHx OK` signals of the seven channels function blocks of the TDOL-0724P, as indicated in Figure 364 on page 598.

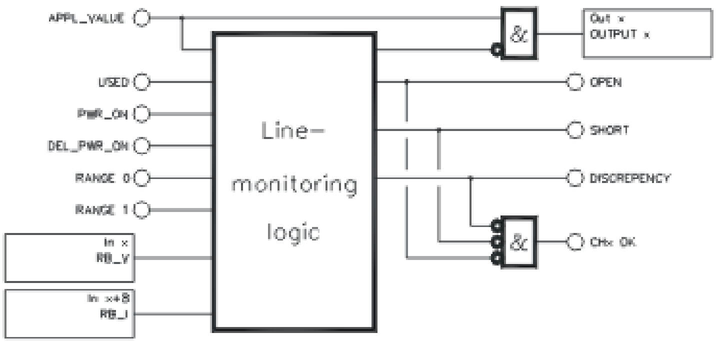
  If all channels are OK, the `MODULE OK` output is `high`.

Channel function blocks

Figure 364 on page 598 shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-0724P FTA.

Figure 364 Example of a channel function block



A standard channel function block as shown in Figure 364 on page 598 has:

- an application value input `APPL_VALUE`
- a `USED` input to prevent lead breakage (`OPEN`) indications on unused channels.
- four inputs that must be linked to the common function blocks (for details see “Common function blocks” on page 596)
- one input for the voltage readback result `RB_V` of each channel (IN `1` thru `7`)
- one input for the current readback result `RB_I` of each channel (IN `9` thru `15`)
- one output for the output relay OUT of each channel (DO channel 1 thru 7)
- a `SHORT` output that indicates a short-circuit on the field wires (a `SHORT` detection also blocks the energization of the output relay)
- an `OPEN` output that indicated lead-breakage on the field wires (or output fuse blown)
- a `DISCREPENCY` output that indicates:
  - Field output is `on` while relay not energized or
  - Field output is `low`, while relay energized.
- a `CHx OK` output if no (line monitoring) errors are detected

Channel assignment:

When connected to the TDOL-0724P the IO channels of the SDO-0824 and the SDI-1624 are assigned as follows:

Field channel TDOL-0724P	Controlling outputs SDO-0824[1]	line monitoring inputs SDI-1624[2] RB_V	RB_I
Channel 1	Output 1	Input 1	Input 9
Channel 2	Output 2	Input 2	Input 10
Channel 3	Output 3	Input 3	Input 11
Channel 4	Output 4	Input 4	Input 12
Channel 5	Output 5	Input 5	Input 13
Channel 6	Output 6	Input 6	Input 14
Channel 7	Output 7	Input 7	Input 15

1 Channel 8 is assigned to the voltage range switcher (`RANGE`) in the common function block

2 Channel 8 is assigned to the 24V power monitor (`RB_PWR`)
Channel 16 is unused.

Applications

For correct operation the TDOL-0724P must be combined with:

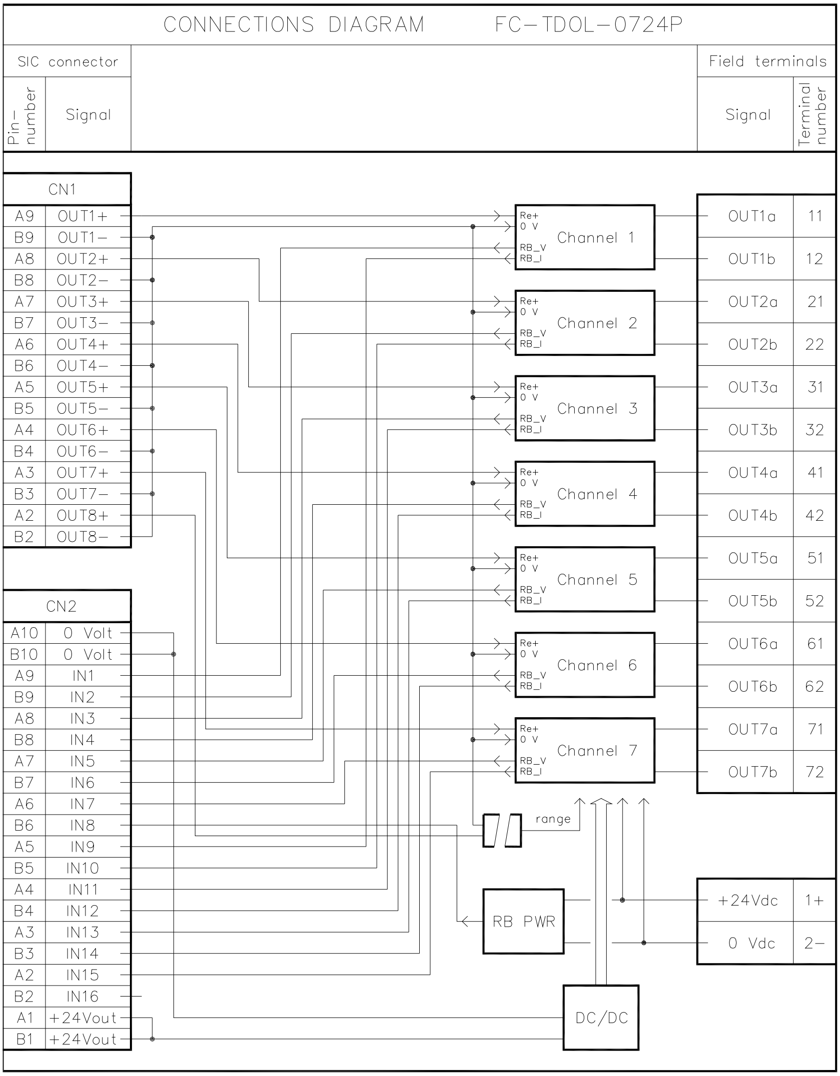
- a (redundant pair of) SDO-0824 module(s),
- a (redundant pair of) SDI-1624 module(s) and
- dedicated function blocks in the application.

For details on applications and connection options for the TDOL-0724P module, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TDOL-0724P module is as follows:

Figure 365 Connections diagram



SIC-connector CN1 (see Figure 359 on page 593 and Figure 365 on page 600) must be connected with the (redundant pair of) SDO-0824 module(s).

SIC-connector CN2 (see Figure 359 on page 593 and Figure 365 on page 600) must be connected with the (redundant) SDI-1624.

The TDOL-0724P has 7 pairs of terminals to connect the load.

External power

A 24 Vdc power distribution cable (see datasheet "PDC-MB24-y" on page 814 for details) can be used to connect the main busbar with the power connector on the TDOL-0724P module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

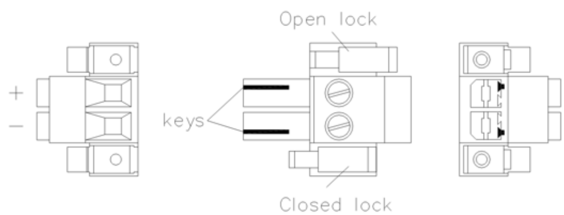
Note:

The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

Figure 366 on page 601 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked **+** is pin 1: connected to +24Vdc busbar.
- The pin marked **-** is pin 2: connected to the 0Vdc busbar.

Figure 366 Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view



The two (red) locking slides of the cable-connector in Figure 366 on page 601 keep the cable-connector locked when inserted into the power connector.

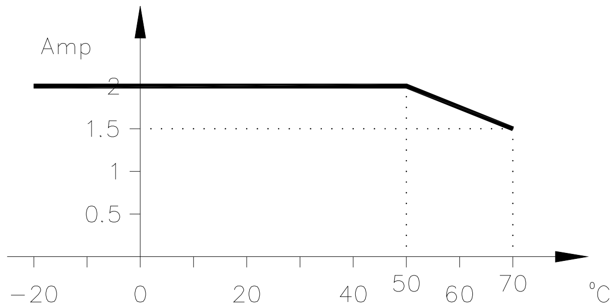
Grounding

Connect a ground wire to the (free) screw on the top left-side of the heatsink (see Figure 359 on page 593 for location) if grounding of metal parts is required.

Maximum output load

Figure 367 on page 602 shows the maximum channel load vs the ambient temperature.

Figure 367 Derating curve (channel load vs ambient temperature) for the TDOL-0724P



Technical data

The TDOL-0724P module has the following specifications:

General	Type numbers[1]:	FC-TDOL-0724P
	Approvals:	CE; TUV, UL, CSA pending
Outputs	Number of channels:	7
	Max. output current:	2 Amp
	Output load 24Vdc:	resistive or inductive with spark suppression diode
	Channel fuses:	5 x 20 mm (0.20 x 0.79 in) 2 Amp (slow-acting)
	Output supply voltage:	24Vdc +/- 20%
	Maximum load resistance:	2200Ω
	Leakage current to load:	approx. 1.1mA at 24V
	No load output voltage: • output OFF • output ON	 90% of output supply voltage 100% of output supply voltage
	Short-circuit detection load threshold:	$200\Omega < R_{Th} < 400\Omega$

Relay contact	Max switched power:	150 Watts
	Expected life: • electrical • mechanical	 100,000 switch operations 30,000,000 switch operations
Power consumption	Field power	
	24Vdc:	< 9mA (all channels off)
	24 Vdc (consumed via SDO-0824 and SDI-1624 IO)	
	Relais + channel 8:	approx. 200mA (out of TSDO-0824) max. 250mA at V_{max}
	Read back circuit:	< 110mA (single SDI-1624) or < 210mA (redundant SDI-1624) max. 275mA at V_{max}
Physical	Module dimensions:	240 x 109 x 80 mm (L x W x H) 9.45 x 4.29 x 3.15 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241mm (9.49 inch)
Termination	Channel screw terminals: • max wire diameter • strip length • tightening torque	 2.5 mm^2 (AWG 14) 7 mm (0.28 in) 0.5 Nm (0.37 ft-lb)
	Power connector • make and type: • strip length: • Connectable conductors:	2 pole header with keying Weidmuller: BVZ 7.62HP/02/180F SN (conn.) Weidmuller: BV/SV7.62HP KO (keys) 8 mm (0.28 in) 0.5-6mm^2 (AWG 20-AWG 10)

1 FC-type modules are conformal coated modules.

TDOL-0724U

Line-monitored relay contact digital output (7 channels, 24Vdc, RUSIO)

Description

The field termination assembly module TDOL-0724U is an interface to field loads that require 24Vdc line-monitored digital outputs.

The TDOL-0724U has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads upto 50Watt.

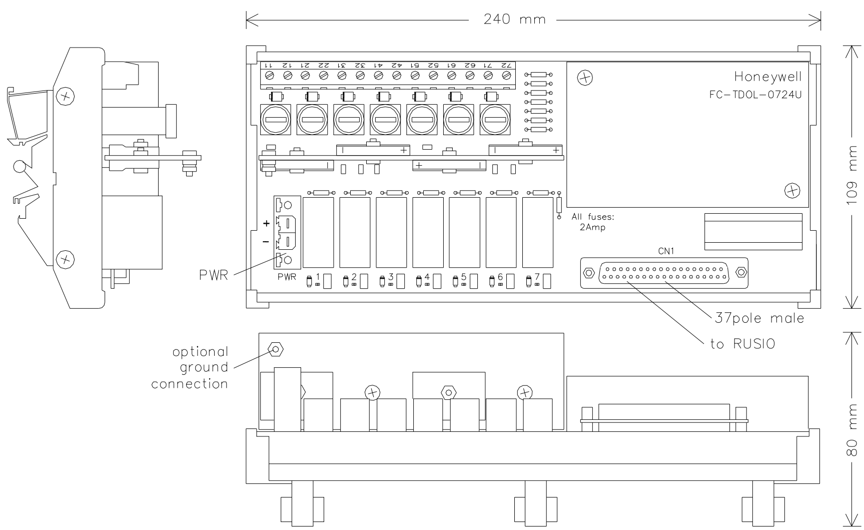
Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either **energized** or **de-energized**.

For these line-monitoring diagnostics the TDOL-0724U operates in combination with 16 RUSIO channels (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-0724U has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and a (2-pole) power connector (PWR) for the common supply connection.

Figure 368 Mechanical layout



Main functions and usage

The TDOL-0724U is connected to a (non-redundant or redundant) IOTA via a CA-HWC300-AIO-DIO-xxM cable.

- A fused relay contact connects the common field supply voltage (24Vdc) with the field terminals. The 7 output relays are controlled by DO1-7 or DO17-23 of the RUSIO-3224. A led indicates the state of its output relay.
- Each output channel has a line-monitoring circuit. The line-monitoring circuit is powered by RUSIO channel 8 or 24. The (4-20mA) line-monitoring outputs are connected with analog inputs AI9-15 or AI25-31 of the RUSIO-3224.
- Presence of a proper common field supply voltage is monitored by a PWR_ON monitor that is connected with Line-Monitored Digital Input 16 or 32 of the RUSIO-3224.
- Special application logic drives the outputs and processes the line monitoring result.

Line-monitoring circuit output

The line-monitoring output has 5 states:

- 5 mA indicating a lead-breakage in the field wires
- 7 mA indicating an open contact output situation on the field wires
- 9 mA indicating a closed contact output situation on the field wires
- 11 mA indicating a short-circuit situation on the field wires
- other; indicating an error (e.g. loss of power)

Schematic diagram of a channel

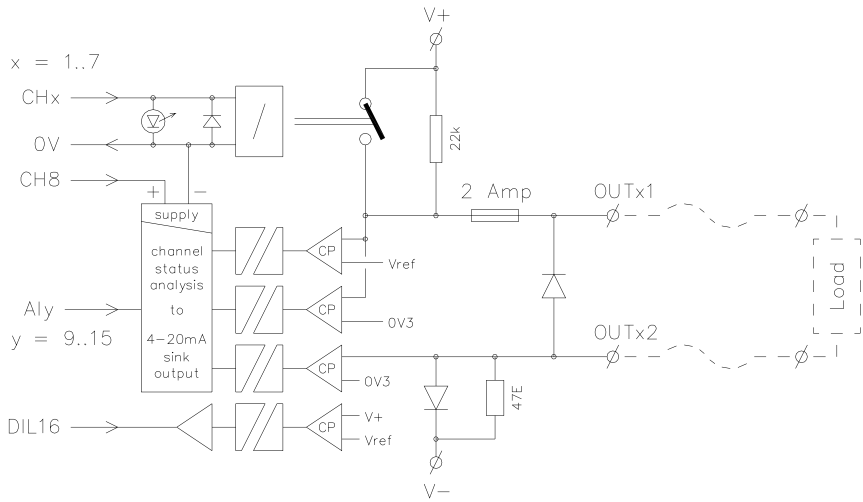
Figure 369 on page 606 shows a schematic diagram of a channel. Each channel consists of:

- one relay with indicator LED
- a fused (2 AT) contact output
- a current injection resistor (22kΩ)
- a voltage readback circuit
- a current sense connection and a current readback circuit

The common part of the module (see Figure 373 on page 611) consists of:

- a DC/DC converter to supply the voltage- and current- readback circuits
- a supply voltage monitor (generating the `RB_PWR` signal)

Figure 369 Schematic diagram of a channel



Lead breakage detection

Lead breakage in a channel is detected if:

- The channel is `off` and the 22kΩ channel resistor (see Figure 369 on page 606) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is `on` and the current readback (RB_I) threshold (approx. `0.3V`) is *not* met.

Note:

A blown channel fuse will be indicated as lead breakage of that channel.

Short circuit detection

Short circuit in a channel is detected if:

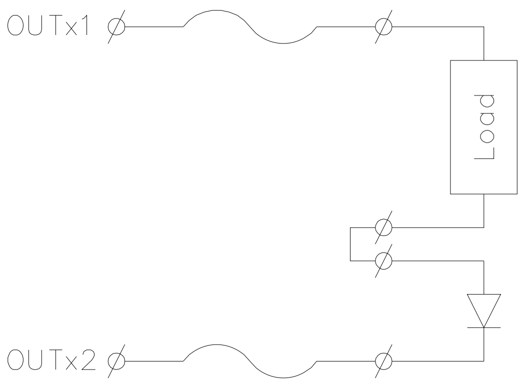
- The channel is `off` and the 22kΩ channel resistor (see Figure 369 on page 606) is not able to create a field voltage drop higher than the `low` threshold value (approx. `0.3V`).
- The channel is `on`. This will blow the channel fuse and will be indicated as lead breakage.

Field loads with a resistance below 400Ω

Field loads with a resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional diode can be wired in series with the load as shown in Figure 370 on page 607. Behind this diode the short circuit detection is “blind”, so this diode should be placed as close to the load as possible.

Figure 370 Additional diode for loads < 400Ω



Note:

The additional diode for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7Amp, or of type 1N5404 (or equivalent) for loads up to 2 Amp.

Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

“Common function blocks” on page 608 and “Channel function blocks” on page 609 explain the function of this special application logic.

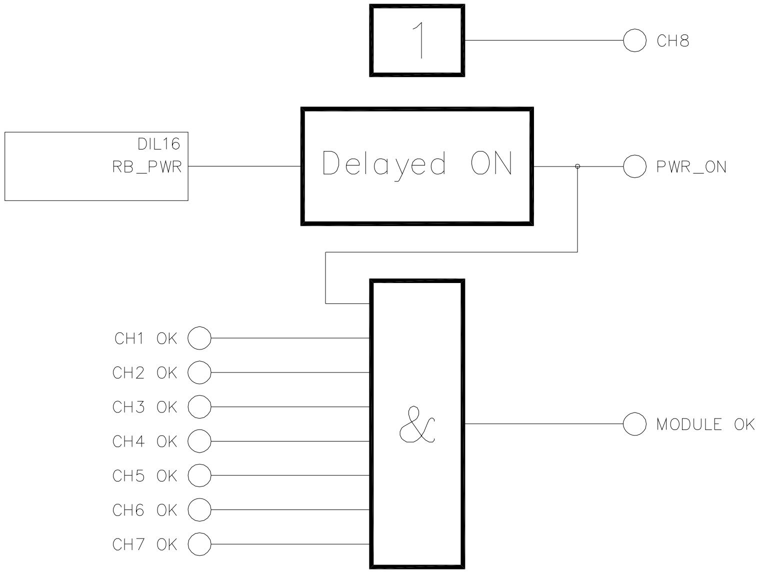
Note:

Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

Common function blocks

Figure 371 on page 608 shows the schematic of the common function block required for the TDOL-0724U.

Figure 371 Example of the delay and OK function block



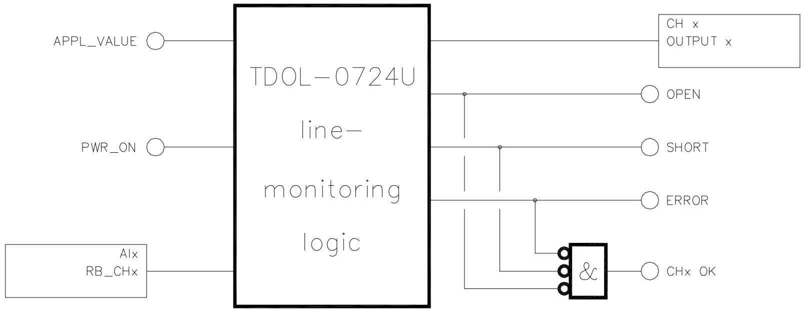
The delay and OK function block is common per TDOL-0724U.

- The Delay logic monitors the presence of 24V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the `CHx OK` signals of the seven channels function blocks of the TDOL-0724U, as indicated in Figure 372 on page 609.
  If all channels are OK, the `MODULE OK` output is `high`.
- Connect a “1” with SPARE or unused channels of the AND-gate.

Channel function blocks

Figure 372 on page 609 shows the schematics of the channel function blocks. One channel function block is needed per channel of the TDOL-0724U FTA.

Figure 372 Example of a channel function block



A standard channel function block as shown in Figure 372 on page 609 has:

- an application value input `APPL_VALUE`
- a PWR_ON input that must be linked to the common function block (for details see "Common function blocks" on page 608)
- one input for the voltage readback result `RB_CHx` of each channel (AI `9` thru `15`)
- one output for the output relay OUT of each channel (DO `1` thru `7`)
- a `SHORT` output that indicates a short-circuit on the field wires (a `SHORT` detection also blocks the energization of the output relay)
- an `OPEN` output that indicated lead-breakage on the field wires (or output fuse blown)
- an `ERROR` output that indicates:
  - Field output is `on` while relay not energized or
  - Field output is `low`, while relay energized.
- a `CHx OK` output if no (line monitoring) errors are detected

Channel assignment:

When connected to the TDOL-0724U the IO channels of the RUSIO-3224 are assigned as follows:

Field channel TDOL-0724U	RUSIO-3224 channel	type
CH 1	DO1 or DO17	DO
CH 2	DO2 or DO18	DO
CH 3	DO3 or DO19	DO
CH 4	DO4 or DO20	DO
CH 5	DO5 or DO21	DO
CH 6	DO6 or DO22	DO
CH 7	DO7 or DO23	DO
CH 8	DO8 or DO24	DO
RB_CH 1	AI9 or AI25	4-20mA
RB_CH 2	AI10 or AI26	4-20mA
RB_CH 3	AI11 or AI27	4-20mA
RB_CH 4	AI12 or AI28	4-20mA
RB_CH 5	AI13 or AI29	4-20mA
RB_CH 6	AI14 or AI30	4-20mA
RB_CH 7	AI15 or AI31	4-20mA
RB_PWR	DIL16 or DIL32	DIL

Applications

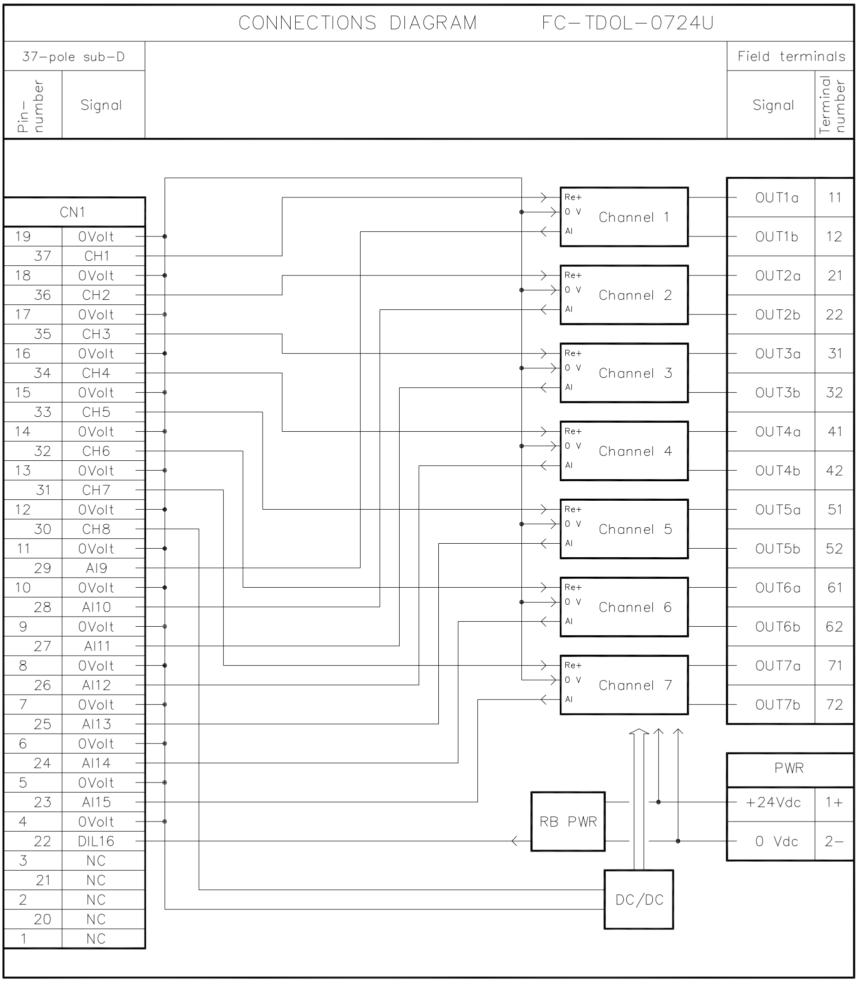
For correct operation, the TDOL-0724U must be combined with 16 channels of a (redundant set of) universal IO module(s).
A cable[1] of suitable lenght is used to connect the TDOL-0724U with an (redundant or non-redundant) IOTA.

1. Honeywell type numbers that are available: 4213509 up to and including 4212516. These type numbers correspond with part number CA-HWC300-AIO-DIO-xxM (Pepperl & Fuchs), where ‘xx’ stands for the length in meters. For details see the manufacturer’s data sheet (Pepperl & Fuchs).

Connections

The connections diagram of the TDOL-0724U module is as follows:

Figure 373 Connections diagram



The following connections apply:

- connector CN1 (37 pole Dsub male) must be connected with the IOTA
- 24Vdc (field-)power must be connected on connector PWR

The TDOL-0724U has 7 pairs of terminals to connect the load.

External power

A 24 Vdc power distribution cable (see datasheet “PDC-MB24-y” on page 814 for details) can be used to connect the main busbar with the power connector on the TDOL-0724U module.

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

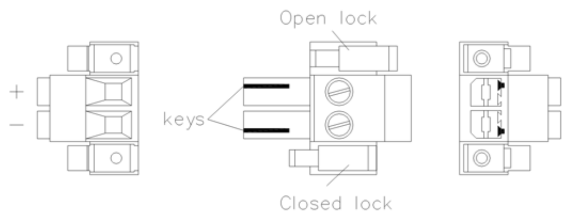
Note:

The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

Figure 374 on page 612 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked **+** is pin 1: connected to +24Vdc busbar.
- The pin marked **-** is pin 2: connected to the 0Vdc busbar.

Figure 374 Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view



The two (red) locking slides of the cable-connector in Figure 374 on page 612 keep the cable-connector locked when inserted into the power connector.

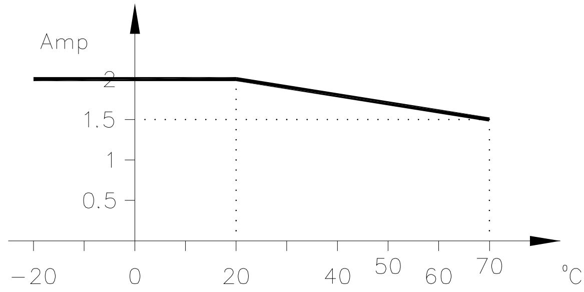
Grounding

Connect a ground wire to the (free) screw on the top left-side of the heatsink (see Figure 368 on page 604 for location) if grounding of metal parts is required.

Maximum output load

Figure 375 on page 613 shows the maximum channel load vs the ambient temperature.

Figure 375 Derating curve (channel load vs ambient temperature) for the TDOL-0724U



Technical data

The TDOL-0724U module has the following specifications:

General	Type numbers[1]:	FC-TDOL-0724U
	Approvals:	CE; TUV, UL, CSA pending
Outputs	Number of channels:	7
	Max. output current:	2 Amp
	Output load 24Vdc:	resistive or inductive with spark suppression diode
	Channel fuses:	5 x 20 mm (0.20 x 0.79 in) 2 Amp (slow-acting)
	Output supply voltage:	24Vdc +/- 20%
	Module voltage drop:	max. 1 Volt (at 2 Amp)
	Minimum required load:	2200Ω
	Leakage current to load:	max. 1.1mA at 24V
	No load output voltage: • output OFF • output ON	 95% of output supply voltage 100% of output supply voltage
	Short-circuit detection threshold on field wires:	$200\Omega < R_{Th} < 400\Omega$

Return signals	4-20mA channels: • lead breakage • open contact • closed contact • short circuit	 5 mA +/- 1 mA 7 mA +/- 1 mA 9 mA +/- 1 mA 11 mA +/- 1 mA
	DIL channel: • Field voltage low • Field voltage OK	 15 kΩ +/- 2% 5 kΩ +/- 2%
Relay contact	Max switched power:	150 Watts
	Expected life: • electrical • mechanical	 100,000 switch operations 30,000,000 switch operations
Power consumption	PWR connector:	<10 mA (internal) + Field load
	CN1 connector:	max. 350 mA at 24Vdc
Physical	Module dimensions:	240 x 109 x 80 mm (L x W x H) 9.45 x 4.29 x 3.15 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241mm (9.49 inch)
Termination	Screw terminals: • max wire diameter • strip length • tightening torque	 2.5 mm^2 (AWG 14) 7 mm (0.28 in) 0.5 Nm (0.37 ft-lb)
	Power connector: • make and type: • strip length: • Connectable conductors:	2 pole header with keying Weidmuller: BVZ 7.62HP/02/180F SN BK (conn.) Weidmuller: BV/SV7.62HP KO (keys) 8 mm (0.28 in) 0.5-6mm^2 (AWG 20-AWG 10)
	CN1 connector:	37 pole Dsub female (cable side)

1 FC-type modules are conformal coated modules.

TDOL-07120

Line-monitored relay contact digital output (7 channels, 120Vac/120Vdc)

Description

The field termination assembly module TDOL-07120 is an interface to field loads that require 120Vac or 120Vdc line-monitored digital outputs.

The TDOL-07120 has 7 (2A) fused relay contact outputs that may be used for non-safety related resistive or inductive field loads up to 240VA or 150Watt.

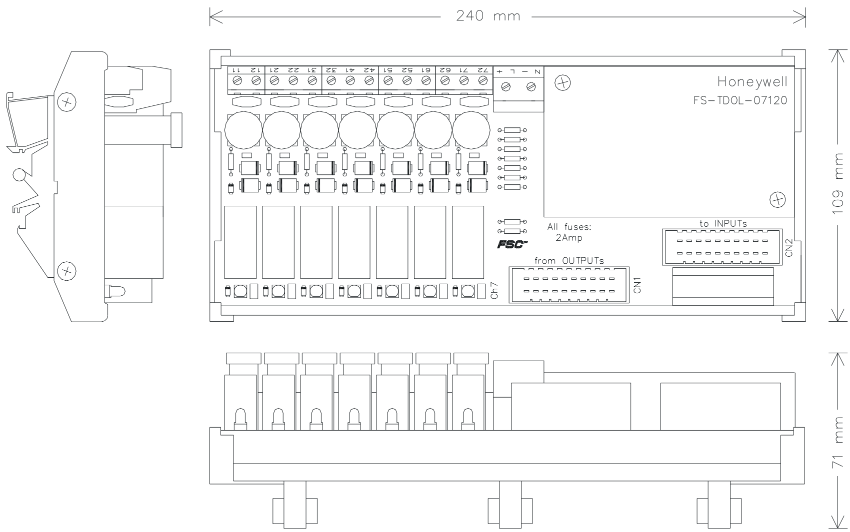
Per channel dedicated line monitoring circuits support both short-circuit and lead-breakage detection while the output is either **energized** or **de-energized**.

For these line-monitoring diagnostics the TDOL-07120 operates in combination with standard DI and DO modules of Safety Manager (configured as either redundant or non-redundant IO).

This overall Safety Manager hardware configuration comes with dedicated application software, loadable from the Safety Manager Function Library.

The TDOL-07120 has universal snap-in provisions for standard DIN EN rails, (7 pairs of) screw terminals for the field wiring and (a pair of) screw terminals for the common supply connection.

Figure 376 Mechanical layout



Main functions and usage

The TDOL-07120 is connected to a (non-redundant or redundant) SDO-0824 output module and a (non-redundant or redundant) SDI-1624 input module via system interconnection cables (SICs).

- A fused relay contact connects the common supply voltage (120Vac or 120Vdc) with a field terminal. The 7 output relays are controlled by channel 1 to 7 of the SDO-0824. A LED indicates the state of its output relay.
- Each output channel has line-monitoring circuits. The line-monitoring circuits are controlled by channel 8 of the SDO-0824 and are wired to channel 1 to 15 of the SDI-1624.
- Special application logic drives the outputs and processes the line monitoring results.

Schematic diagram of a channel

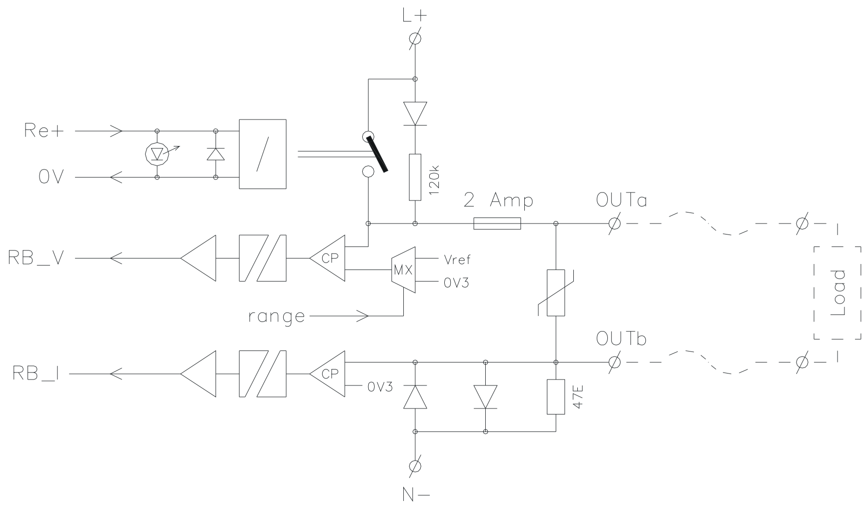
Figure 377 on page 617 shows a schematic diagram of a channel. Each channel consists of:

- one relay with indicator LED
- a fused (2 AT) contact output
- a current injection resistor (120kΩ)
- a voltage readback circuit (with two ranges)
- a current sense connection and a current readback circuit

The common part of the module (see Figure 383 on page 623) consists of:

- a DC/DC converter to supply the voltage- and current- readback circuits.
- a supply voltage monitor (generating the `RB_PWR` signal)
- an opto-coupler to transfer the range switch command from the 24V side to the 120V side.

Figure 377 Schematic diagram of a channel



Lead breakage detection.

Lead breakage in a channel is detected if:

- The channel is `off` and the 120kΩ channel resistor (see Figure 377 on page 617) is able to pull the output voltage readback over the V_{ref} threshold.
- The channel is `on` and the current readback (RB_I) threshold (approx. `0.3V`) is *not* met.

Note:

A blown channel fuse will be indicated as lead breakage of that channel.

To prevent lead breakage indication on a spare channel, the `USED` input of that channel (an input of the channel application function block) must be `low`. For details see “Special application logic” on page 619.

Short circuit detection

Short circuit in a channel is detected if:

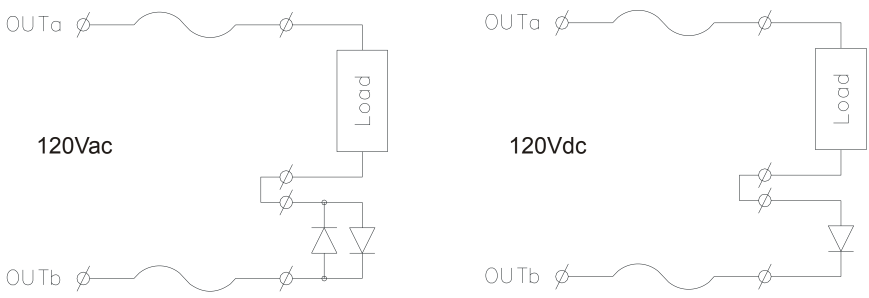
- The channel is `off` and the 120kΩ channel resistor (see Figure 377 on page 617) is not able to create a field voltage drop higher than the `low` threshold value (approx. `0.3V`).
- The channel is `on`. This will blow the channel fuse and will be indicated as lead breakage.

Field loads with a (DC-)resistance below 400Ω

Field loads with a (DC-)resistance below 400Ω may activate the short circuit detection.

To avoid this, an additional (pair of) diode(s) can be wired in series with the load as shown in Figure 378 on page 618. As these diodes prevent loads <400Ω to activate the short circuit detection they should be placed as close as possible to the load.

Figure 378 Additional diodes for loads < 400Ω



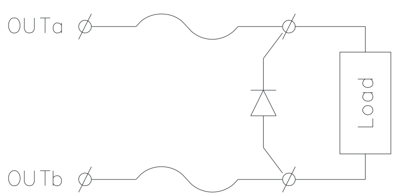
Note:

The additional diode(s) for loads < 400Ω must be of type 1N4004 (or equivalent) at load currents up to 0.7Amp, or of type 1N5404 (or equivalent) for loads up to 2 Amp.

Inductive loads on 120Vdc

Inductive loads on 120Vdc require a spark suppression diode of type 1N4004 (or equivalent) as shown in Figure 379 on page 618.

Figure 379 Spark suppression diode for inductive loads on 120Vdc



Special application logic

Special application logic is required to drive the outputs and monitor the on-board line monitoring electronics.

“Common function blocks” on page 619 and “Channel function blocks” on page 620 explain the function of this special application logic.

Note:

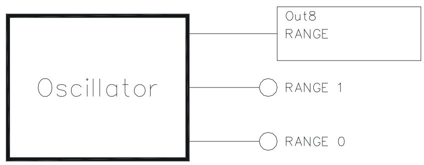
Special function blocks can be provided for in Safety Manager which can be modified to better suit the customers whishes.

Common function blocks

Figure 380 on page 619 and Figure 381 on page 620 show the schematics of the common function blocks required for the TDOL-07120.

Oscillator function block

Figure 380 Example of the oscillator function block



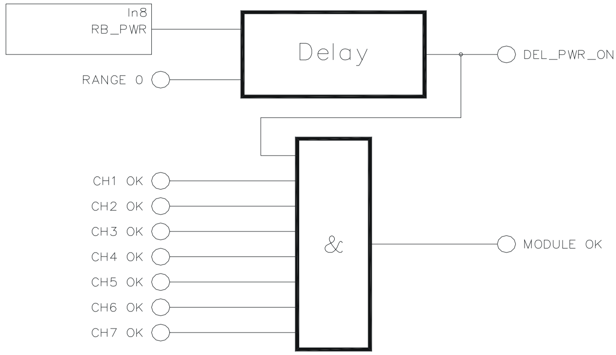
The oscillator function block may be global (one per series of TDOL-07120 FTAs in a Safety Manager).

The oscillator toggles the `RANGE` input of the voltage readback circuits on each TDOL-07120 and controls the latches in each channel function block.

This allows each channel function block to monitor the line for both energized *and* de-energized channels.

Delay and OK function block

Figure 381 Example of the delay and OK function block



The delay and OK function block is common per TDOL-07120.

- The Delay logic monitors the presence of 120V on the field power terminals and provides (power-up) time to stabilize the line monitoring circuits.
- The AND-gate collects the `CHx OK` signals of the seven channels function blocks of the TDOL-07120, as indicated in Figure 382 on page 620.

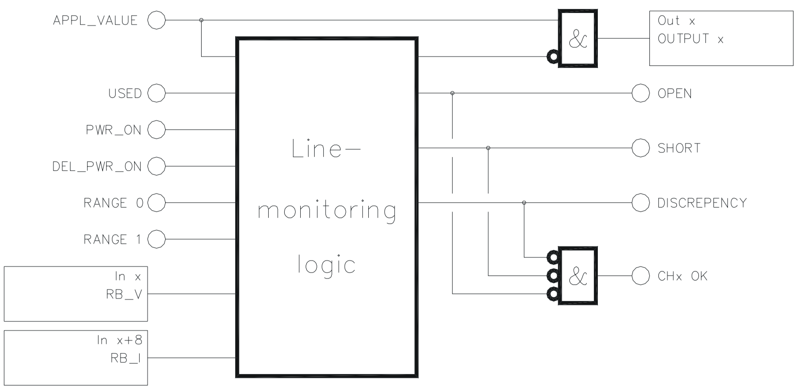
  If all channels are OK, the `MODULE OK` output is `high`.

Channel function blocks

Figure 382 on page 620 shows the schematics of the channel function blocks.

One channel function block is needed per channel of the TDOL-07120 FTA.

Figure 382 Example of a channel function block



A standard channel function block as shown in Figure 382 on page 620 has:

- an application value input APPL_VALUE
- a USED input to prevent lead breakage (OPEN) indications on unused channels.
- four inputs that must be linked to the common function blocks (for details see "Common function blocks" on page 619)
- one input for the voltage readback result RB_V of each channel (IN 1 thru 7)
- one input for the current readback result RB_I of each channel (IN 9 thru 15)
- one output for the output relay OUT of each channel (DO channel 1 thru 7)
- a SHORT output that indicates a short-circuit on the field wires
(a SHORT detection also blocks the energization of the output relay)
- an OPEN output that indicated lead-breakage on the field wires (or output fuse blown)
- a DISCREPENCY output that indicates:
  - Field output is on while relay not energized or
  - Field output is low, while relay energized.
- a CHx OK output if no (line monitoring) errors are detected

Channel assignment:

When connected to the TDOL-07120 the IO channels of the SDO-0824 and the SDI-1624 are assigned as follows:

Field channel TDOL-07120	Controlling outputs SDO-0824[1]	line monitoring inputs SDI-1624[2] RB_V	RB_I
Channel 1	Output 1	Input 1	Input 9
Channel 2	Output 2	Input 2	Input 10
Channel 3	Output 3	Input 3	Input 11
Channel 4	Output 4	Input 4	Input 12
Channel 5	Output 5	Input 5	Input 13
Channel 6	Output 6	Input 6	Input 14
Channel 7	Output 7	Input 7	Input 15

1 Channel 8 is assigned to the voltage range switcher (`RANGE`) in the common function block

2 Channel 8 is assigned to the 120V power monitor (`RB_PWR`)
Channel 16 is unused.

Applications

For correct operation the TDOL-07120 must be combined with:

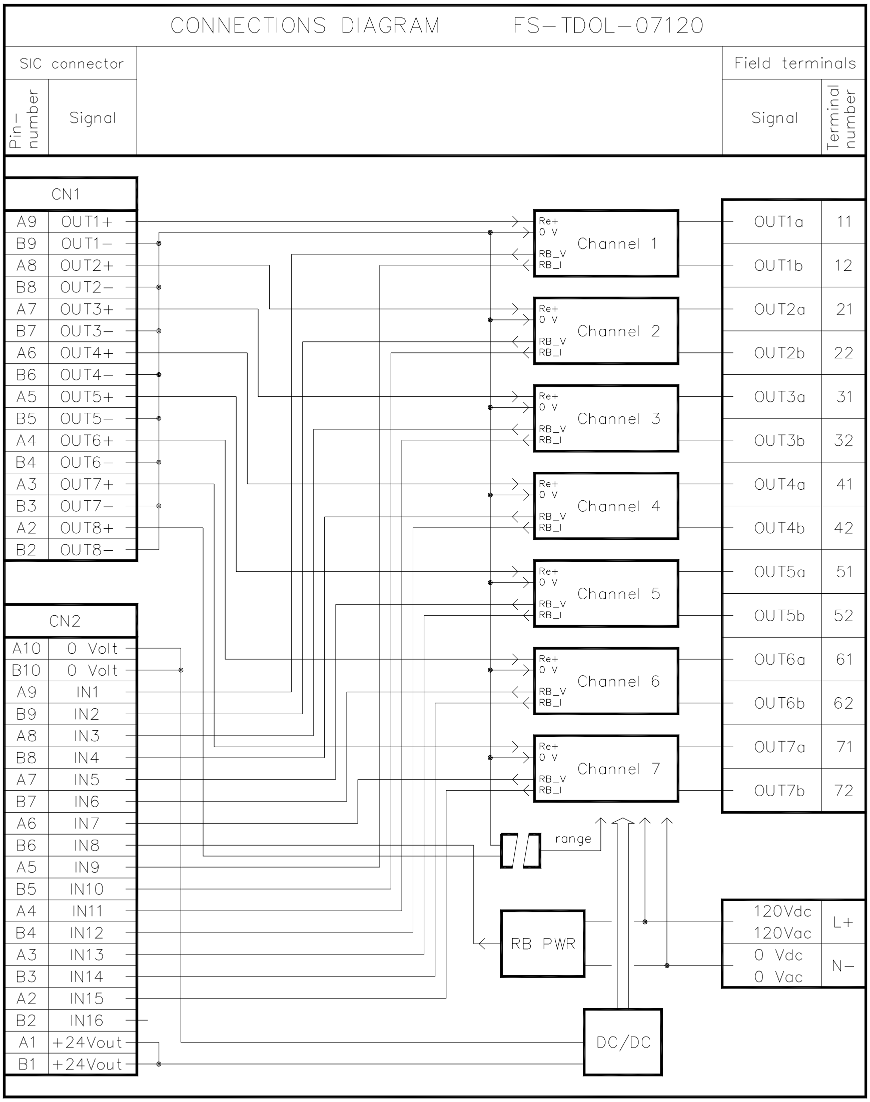
- a (redundant pair of) SDO-0824 module(s),
- a (redundant pair of) SDI-1624 module(s) and
- dedicated function blocks in the application.

For details on applications and connection options for the TDOL-07120 module, see "SICC-0001/Lx" on page 715.

Connections

The connections diagram of the TDOL-07120 module is as follows:

Figure 383 Connections diagram



SIC-connector CN1 (see Figure 376 on page 615 and Figure 383 on page 623) must be connected with the (redundant pair of) SDO-0824 module(s).

SIC-connector CN2 (see Figure 376 on page 615 and Figure 383 on page 623) must be connected with the (redundant) SDI-1624.

The TDOL-7120 has 7 pairs of terminals to connect the load.

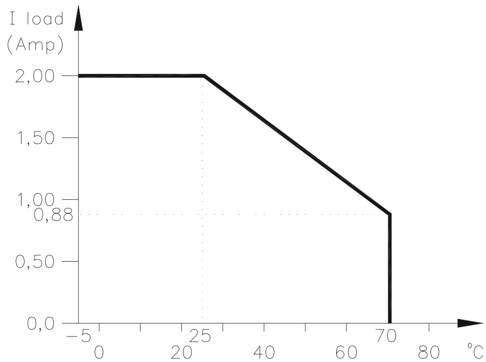
External power must be connected to the TDOL-07120 via the power screw terminal pair marked `L+` and `N-`.

- 120Vac(line) or +120Vdc must be connected with `L+`.
- 0Vac (neutral) or 0Vdc (-) must be connected with `N-`.

Maximum AC output load

Figure 384 on page 624 shows the maximum AC channel load vs. the ambient temperature.

Figure 384 Derating curve (AC channel load vs. ambient temperature) for the TDOL-07120



Technical data

The TDOL-07120 module has the following specifications:

General	Type numbers[1 2]:	FS-TDOL-07120 V1.1
		FC-TDOL-07120 CCV1.1
	Approvals:	CE, UL, CSA; TUV pending
Outputs	Number of channels:	7
	Max. output current:	2 Amp (at 120Vac)[3] 0.28 Amp at 120Vdc (UL limit) 0.5 Amp at 120Vdc (relay limit)
	Output load 120Vdc:	resistive or inductive with spark suppression diode
	Channel fuses:	5 x 20 mm (0.20 x 0.79 in) 2 Amp (slow-acting)
	Output supply voltage:	120VAc or 120Vdc +/- 20%
	Minimum required field load:	1 Watt
	Leakage current to load:	max. 1mA at 120V
	No load output voltage: • output OFF • output ON	 35..130 Vdc with AC output supply or 90% of DC output supply voltage 100% of output supply voltage (AC or DC)
	Short-circuit detection load threshold:	$200\Omega < R_{Th} < 400\Omega$
	Max. load capacitance:	1uF
Relay contact	Max switched power:	1250 VA / 60 Watts
	Expected life: • electrical • mechanical	 100,000 switch operations 30,000,000 switch operations
Power consumption	Field power	
	120Vac/Vdc:	< 8mA (all channels off)
	24 Vdc (consumed via SDO-0824 and SDI-1624 IO)	
	Relays + channel 8:	approx. 200mA (out of TSDO-0824) max. 250mA at V_{max}
	Read back circuit:	< 110mA (single SDI-1624) or < 210mA (redundant SDI-1624) max. 275mA at V_{max}

Physical	Module dimensions:	240 x 109 x 71 mm (L x W x H) 9.45 x 4.29 x 2.80 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	241mm (9.49 inch)
Termination	Channel screw terminals: • max wire diameter • strip length • tightening torque	 2.5 mm2 (AWG 14) 7 mm (0.28 in) 0.5 Nm (0.37 ft-lb)
	Power screw terminals: • max wire diameter • strip length • tightening torque	 16 mm2 (AWG 8) 7 mm (0.28 in) 1.2 Nm (0.88 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have an improved design. There are no functional changes.

3 The AC load current is limited to 0.88 Amp at 70°C, for details see Figure 384 on page 624.

TSDO-0424

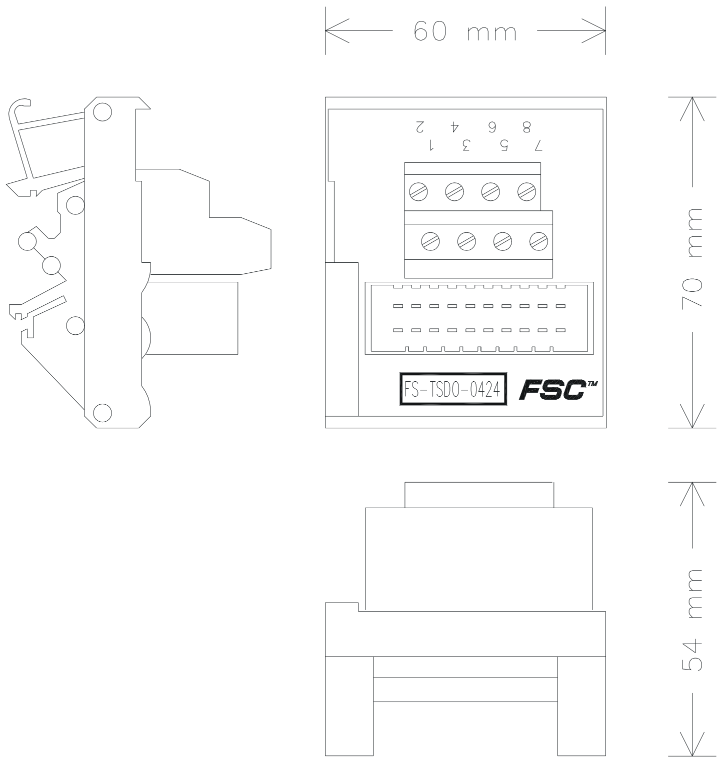
Safe digital output FTA (24 Vdc, 4 channels)

Description

The field termination assembly module TSDO-0424 is the interface between the system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The four channels of a (redundant pair of) SDO-0424 module(s) can be connected to the TSDO-0424 module via the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 385 Mechanical layout



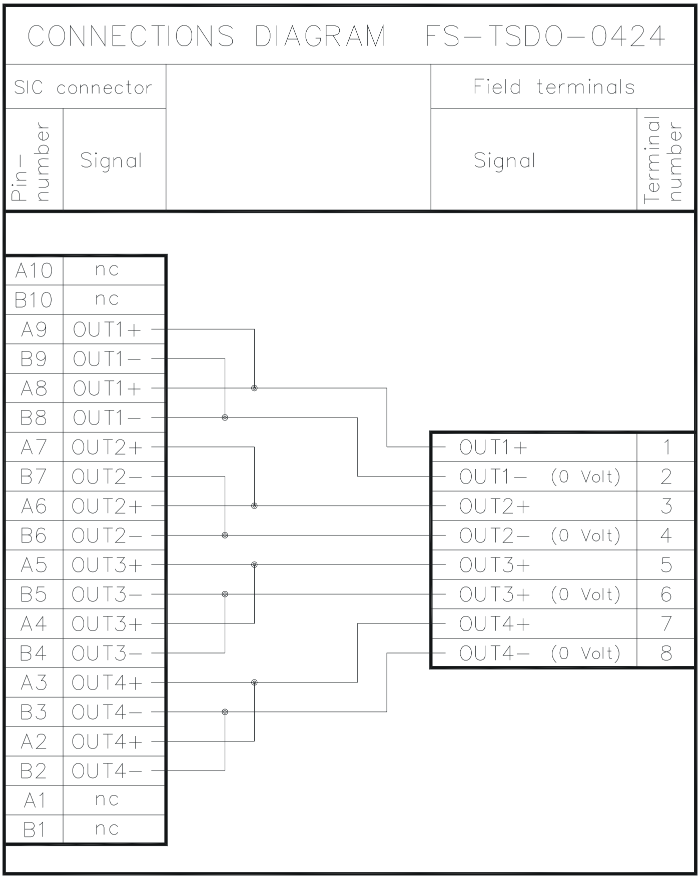
Applications

For details on applications and connection options for the TSDO-0424 module, see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSDO-0424 module:

Figure 386 Connections diagram



Technical data

The TSDO-0424 module has the following specifications:

General	Type numbers[1] :	FS-TSDO-0424
		FC-TSDO-0424
	Approvals:	CE, UL, TUV, CSA
Power	Number of channels:	4
	Maximum voltage:	36 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	4 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	60 × 70 × 54 mm (L × W × H) 2.36 × 2.76 × 2.13 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm^2 (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

TSDO-04UNI

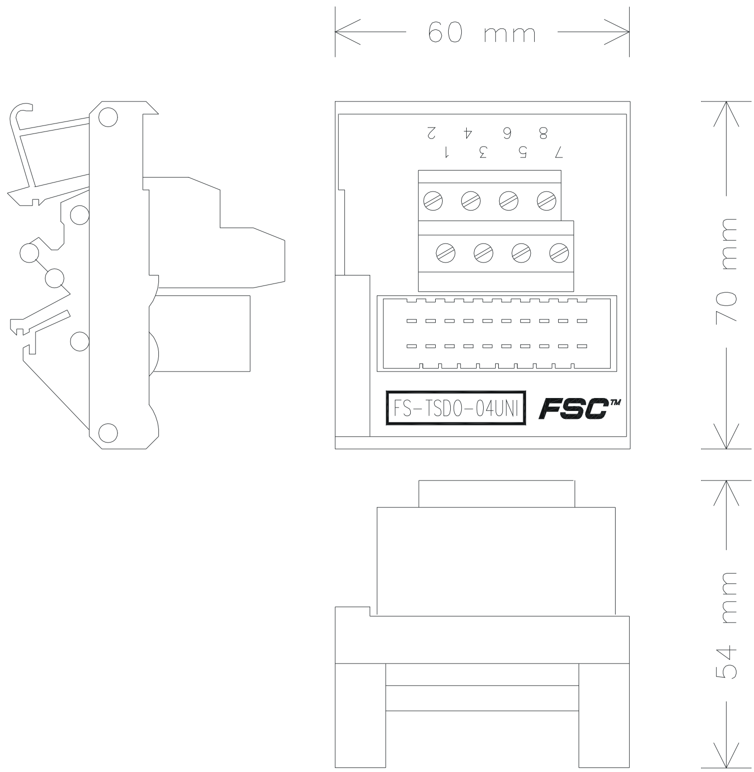
Safe digital output FTA (24/48/110 Vdc, 4 channels)

Description

Field termination assembly module TSDO-04UNI is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). The four channels of a (redundant pair of) SDO-04x module(s) or SDOL-04x module(s) can be connected to the TSDO-04UNI module via system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 387 Mechanical layout



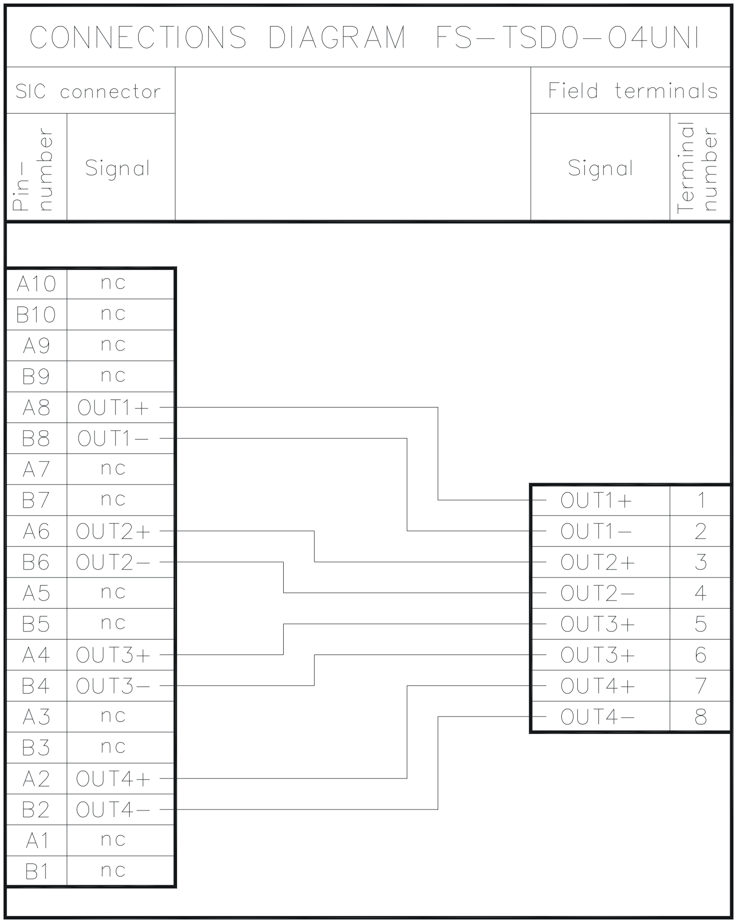
Applications

For details on applications and connection options for the TSDO-04UNI module, see section “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSDO-04UNI module is as follows:

Figure 388 Connections diagram



Technical data

The TSDO-04UNI module has the following specifications:

General	Type numbers[1] :	FS-TSDO-04UNI
		FC-TSDO-04UNI
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	4
	Maximum voltage:	50 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12) 150 Vdc – IEC 1010 (1990), overvoltage category 2 (Table D.10)
	Maximum continuous current per channel:	2 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	60 × 70 × 54 mm (L × W × H)
		2.36 × 2.76 × 2.13 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSDOL-0424C

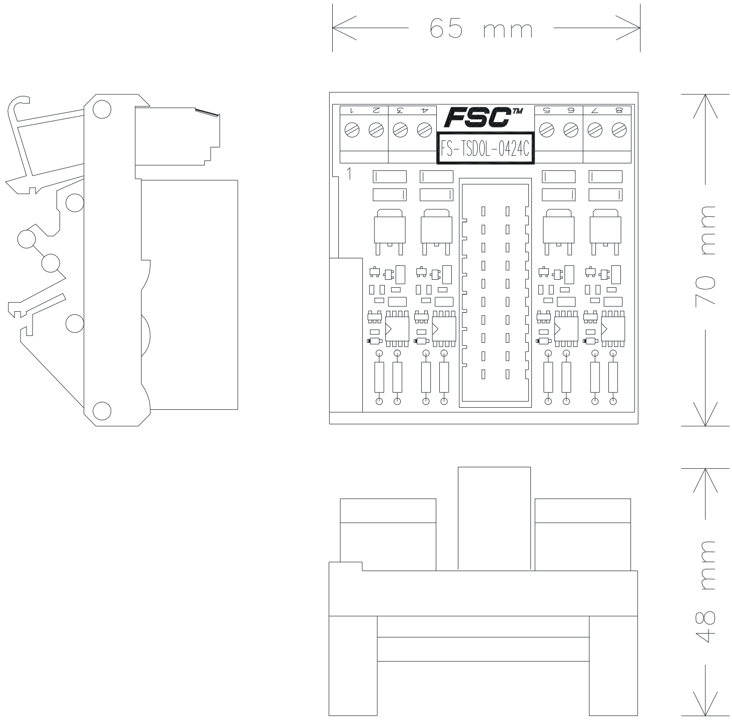
Conformal-coated safe digital output FTA, current limited, loop monitored (24 Vdc, 4 channels)

Description

Field termination assembly module TSDOL-0424C is the interface for safe loop monitored digital output module SDOL-0424 with the system inter- connection cable SICC-0001/Lx and external field wiring (screw terminals). It can be used for interfacing to Class I, Division 2 Hazardous locations. TSDOL-0424C provides four loop-monitored current limited digital outputs to the field. Each output is capable of supplying 110 mA (= 2.5 Watt at 24 Vdc).

The FTA module is coated conform the requirements for type A coatings given in IEC 60664-3 (the values for POLLUTION DEGREE 1 apply), has a universal snap-in provision for standard DIN EN rails, and screw terminals for the field wiring.

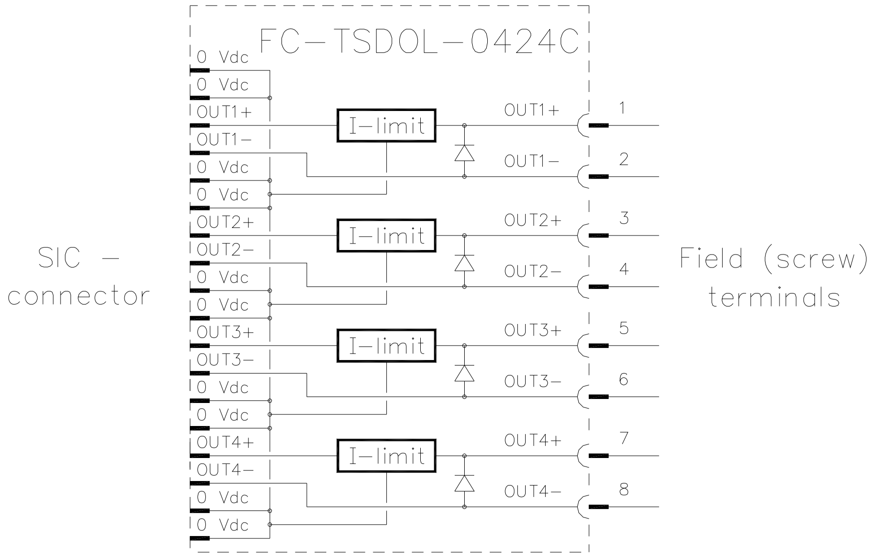
Figure 389 Mechanical layout



Applications

For details on applications and connection options for the TSDOL-0424C module, see section “SICC-0001/Lx” on page 715.

Figure 390 Schematic diagram



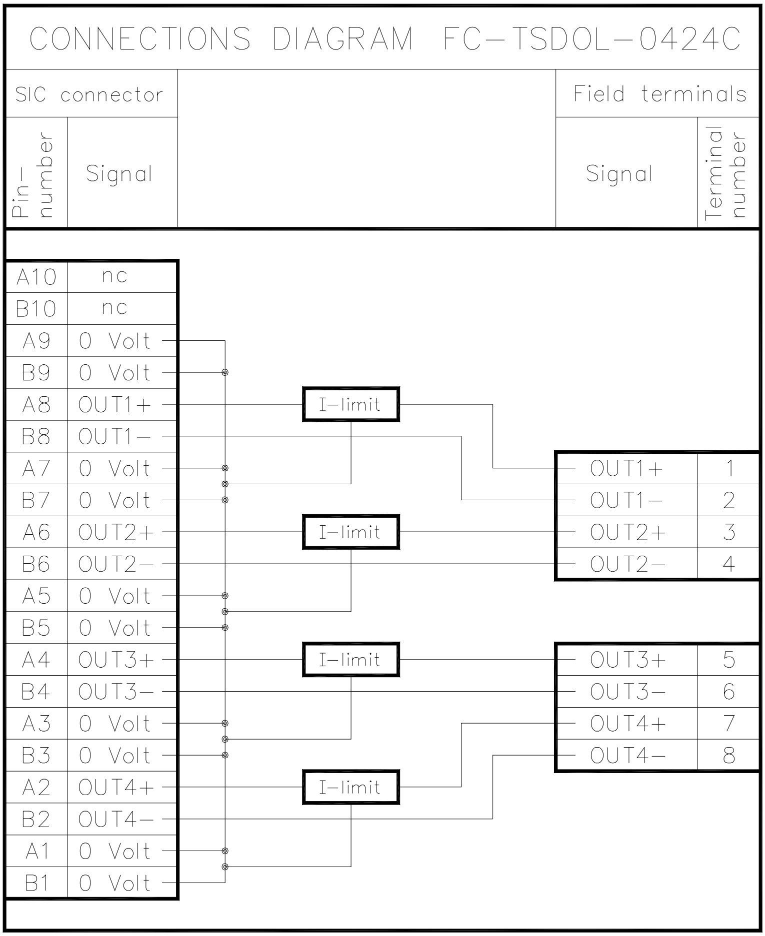
Main function

The TSDOL-0424C can energize loads (for example solenoids or leds) with voltage-current limitation in compliance with Hazardous Class I, Division 2. The external output-signal (OUT+) is electronically current-limited.

Connections

The connections diagram of the TSDOL-0424C:

Figure 391 Connections diagram



Technical data

TSDOL-0424C has the following specifications:

General	Type number[1]:	FC-TSDOL-0424C
	Approvals	CE, TUV, UL, CSA, FM
	Environmental shielding	Conformal coating
Power	Number of channels:	4
	Maximum voltage:	36 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Power requirements:	5 mA per channel (plus output load)
Output	Output current limit:	> 110 mA
	Max. output load:	2.5 Watt (at 24 Vdc)
	Voltage drop:	< 1.5 Vdc at 110 mA
	Off current:	< 0.1 mA
Physical	Module dimensions:	65 × 70 × 48 mm (L × W × H) 2.55 × 2.76 × 1.89 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	66 mm (2.59 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Field signal specifications	HYDROGEN (Group A & B)	
	• Max. loop inductance	3.0 mH
	• Max. loop capacitance	0.2 µF
	NON-HYDROGEN (Group C & D)	
	• Max. loop inductance	12 mH
	• Max. loop capacitance	5 µF

1 FC-type modules are conformal coated modules.

TDO-1624

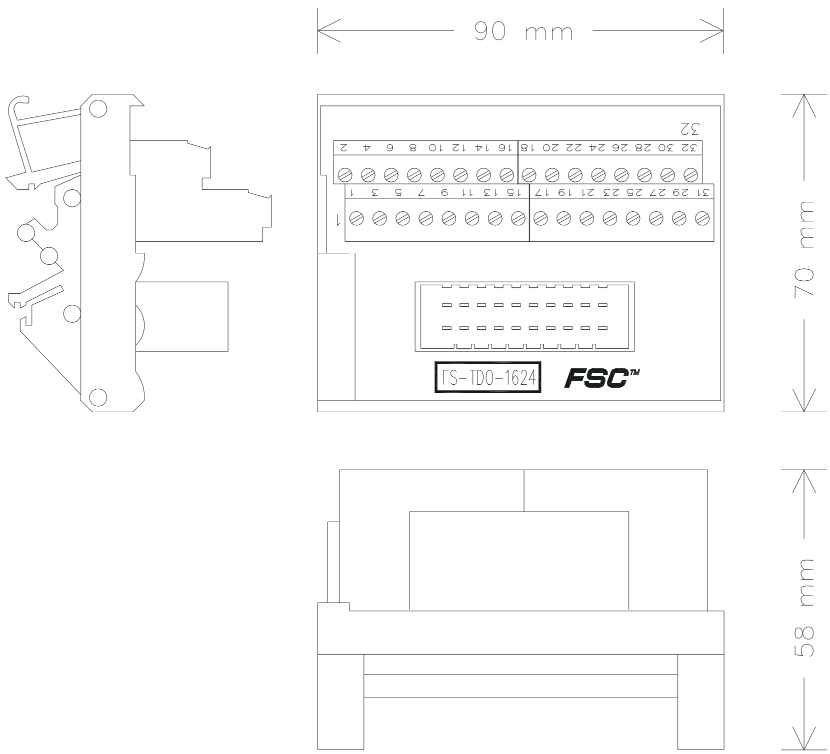
Non-safe digital output FTA (24 Vdc, 16 channels)

Description

Field termination assembly module TDO-1624 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The non-safe channels of a (redundant pair of) DO-1624 module(s) or DO-1224 module(s) can be connected to TDO-1624 via system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails and screw terminals for connecting field wiring.

Figure 392 Mechanical layout



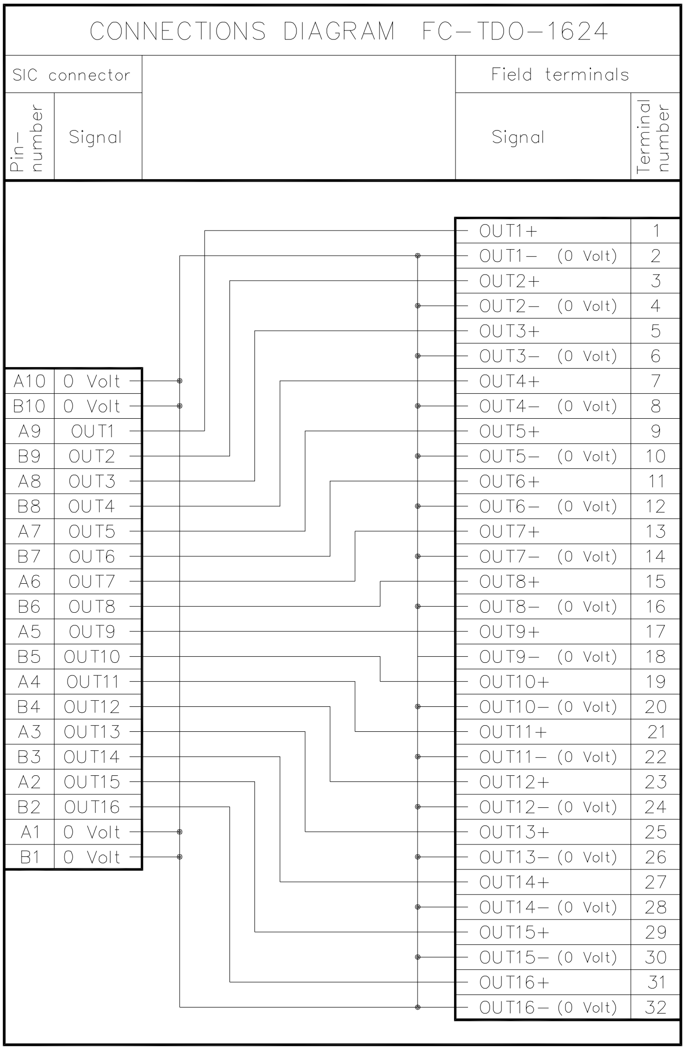
Applications

For details on applications and connection options for TDO-1624, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TDO-1624 module:

Figure 393 Connections diagram



Technical data

The TDO-1624 module has the following specifications:

General	Type numbers[1] :	FS-TDO-1624
		FC-TDO-1624
	Approvals:	CE, UL, TUV, CSA
Power	Number of channels:	16
	Maximum voltage:	36 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	1.5 A
	Actual maximum current defined by connected output module	
Physical	Module dimensions:	90 × 70 × 58 mm (L × W × H)
		3.54 × 2.76 × 2.28 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	91 mm (3.58 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSRO-0824

Safe dry digital output FTA for SIL3 applications (8 channels)

Description

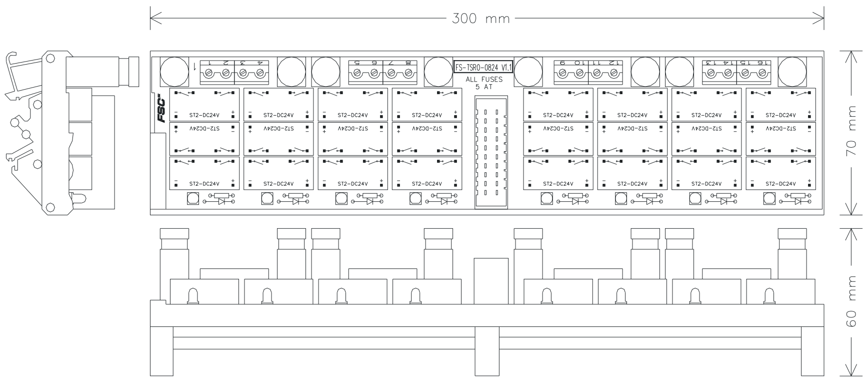
Field termination assembly module TSRO-0824 is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has eight relay-based potential-free safe output channels suitable for applications up to and including SIL3 without the use of fault exclusions. TSRO-0824 complies with safety requirements for general use in safety requirement classes SIL3 as defined in IEC 61508.

The TSRO-0824 has floating, non commoned, output contacts that can be wired independently. Each output channel consists of:

- Three relays
- A fused NO field contact (5 AT, slow-acting)
- A status indication LED

The relays are capable of driving a wide variety of loads, including 115/230 Vac, which gives Safety Manager a 115/230 Vac output capability for SIL3 applications. The energized relay state is indicated by a LED on the module.

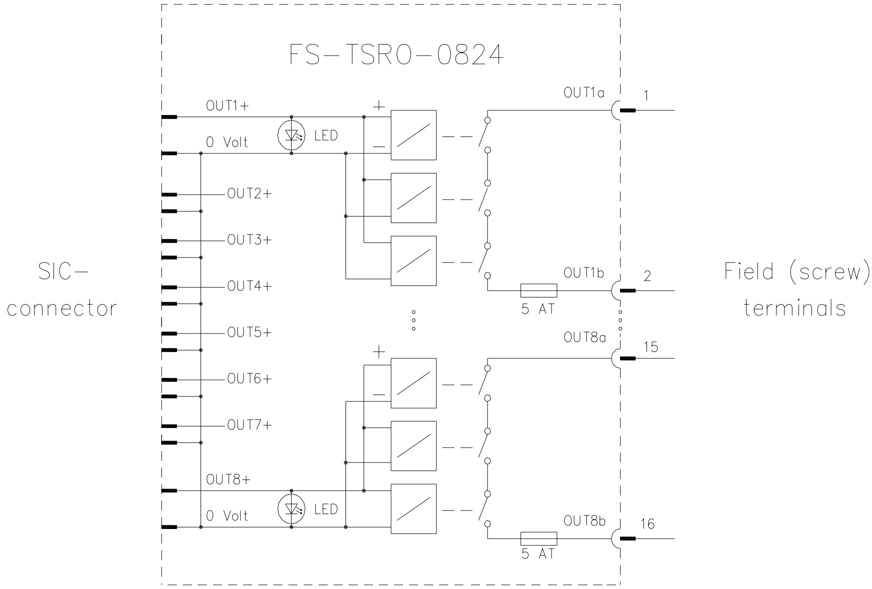
Figure 394 Mechanical layout



Eight channels can be connected to the TSRO-0824 module via system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

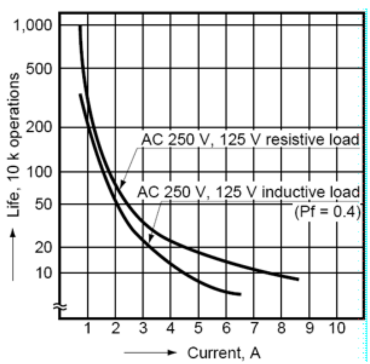
Figure 395 Schematic diagram



Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. Figure 396 on page 642 shows the expected relay life versus contact current.

Figure 396 Life curve of the applied relays



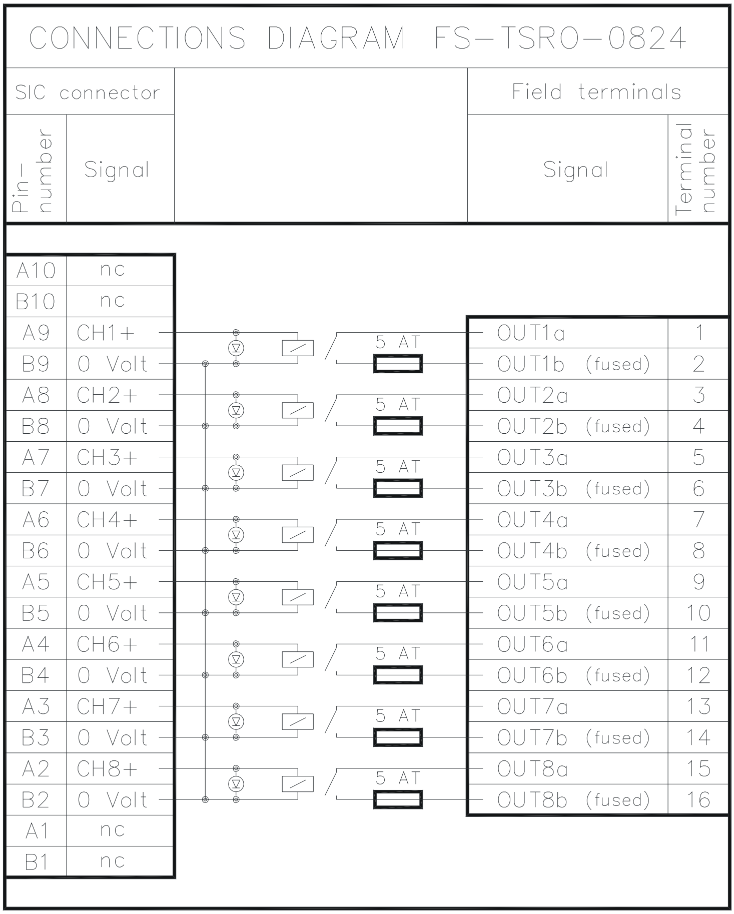
Applications

For details on applications and connection options for TSRO-0824, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSRO-0824 module:

Figure 397 Connections diagram



Technical data

The TSRO-0824 module has the following specifications:

General	Type numbers[1] [2]:	FS-TSRO-0824 V1.1
		FC-TSRO-0824 V1.1
	Approvals:	CE, UL, TUV, CSA
	Safety class:	up to and including SIL3
Input	Nominal input voltage:	24 Vdc
	Max. input voltage:	36 Vdc
	Relay pick-up voltage:	19.2 Vdc
	Input current:	Typically 40 mA at 24 Vdc
Output	Number of output channels:	8
	Max. output current:	5 A (fused)
	Min. output current:	1 mA at 5 V
	Max. output voltage:	250 Vac / 250 Vdc
	Max. switched load:	1250 VA / 150 W (see Figure 398 on page 645)
Fuses	Rating:	5 AT (slow-acting)
	Dimensions:	5 × 20 mm (0.2 × 0.78 in)
Physical	Module dimensions:	300 × 70 × 60 mm (L × W × H) 11.81 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	301 mm (11.85 in)
Termination	Screw terminals:	
	• Max. wire diameter:	2.5 mm² (AWG 14)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Environment	Ambient temperature:	–5°C—+60°C (23°F—140°F)

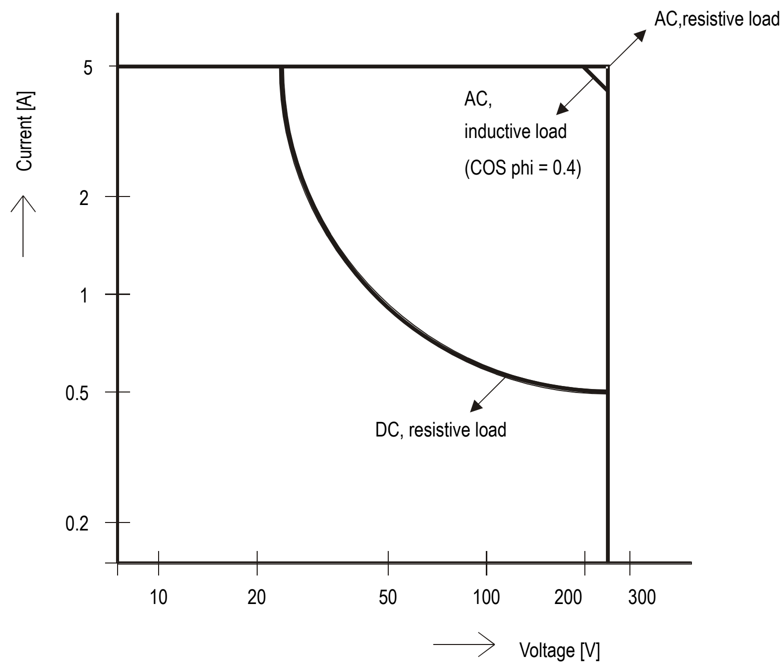
Isolation	Isolation:	
	• Coil to contact	4000 Vac
	• Contact to contact	1200 Vac
Relay contact	Max. switching load:[3]	250 Vac, 5A 24 Vdc, 5A 48 Vdc, 1A 110 Vdc, 500 mA
	Max. switching frequency:	20 Hz
	Expected life:	See Figure 396 on page 642
	Contact material:	gold flash over silver alloy

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 and higher have improved insulation. There are no functional changes.

3 When switching DC loads, only use resistive loads or inductive loads with spark suppression diodes

Figure 398 Maximum switched power



TSRO-08UNI

Safe common external power relay output FTA for SIL3 applications (8 channels)

Description

Field termination assembly module TSRO-08UNI is the interface between system interconnection cable SICC-0001/Lx and the external field wiring (screw terminals). It has eight relay-based safe output channels suitable for applications up to SIL3 without the use of fault exclusions. TSRO-08UNI complies with safety requirements for general use in safety requirement classes SIL3 as defined in IEC 61508.

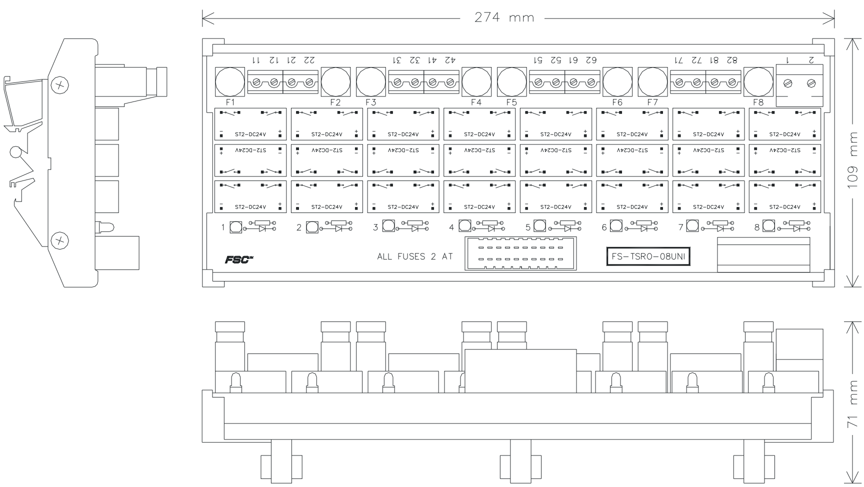
The TSRO-08UNI has one (common) external power connection (screw terminals).

Each channel consists of:

- Three relays
- A fused NO field contact (2 AT, slow-acting)
- A status indication LED

The relays are capable of switching a wide variety of loads, including 115/230 Vac, which gives Safety Manager a 115/230 Vac output for SIL3 applications. The energized relay state is indicated by a LED on the module.

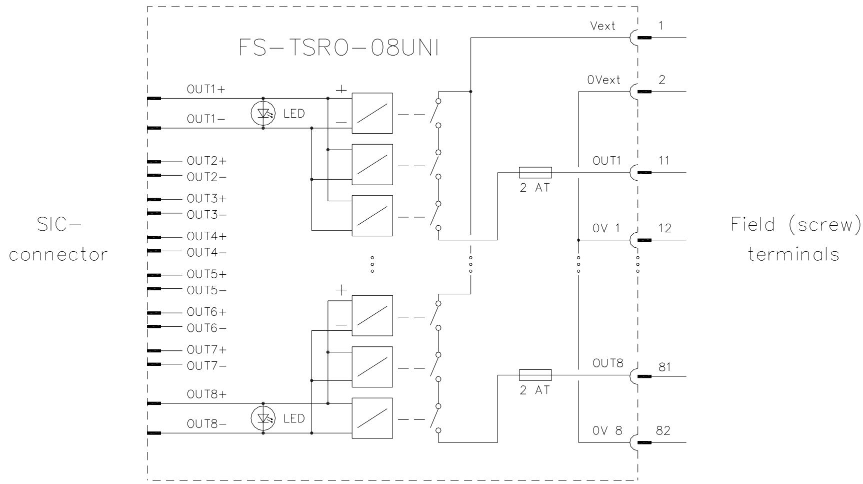
Figure 399 Mechanical layout



Eight channels can be connected to the TSRO-08UNI module via system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

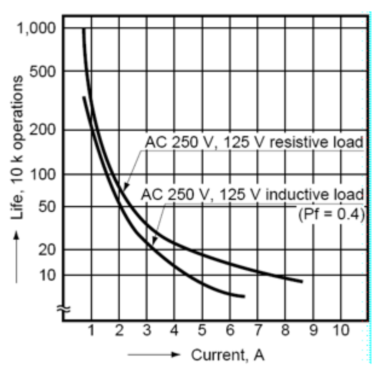
Figure 400 Schematic diagram



Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. Figure 401 on page 647 shows the expected relay life versus contact current.

Figure 401 Life curve of the applied relays



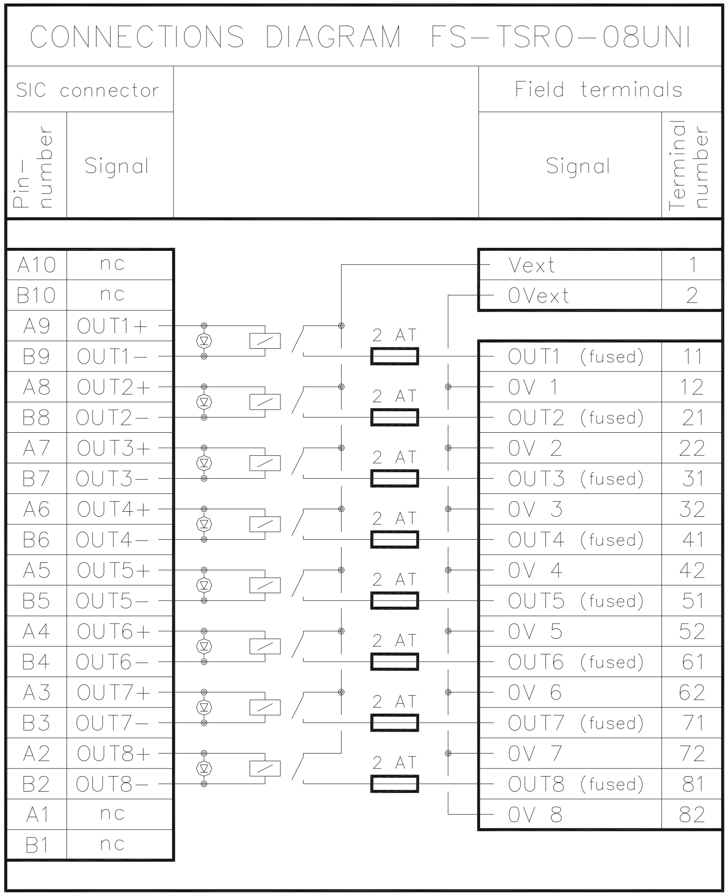
Applications

For details on applications and connection options for TSRO-08UNI, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSRO-08UNI module:

Figure 402 Connections diagram



Technical data

The TSRO-08UNI module has the following specifications:

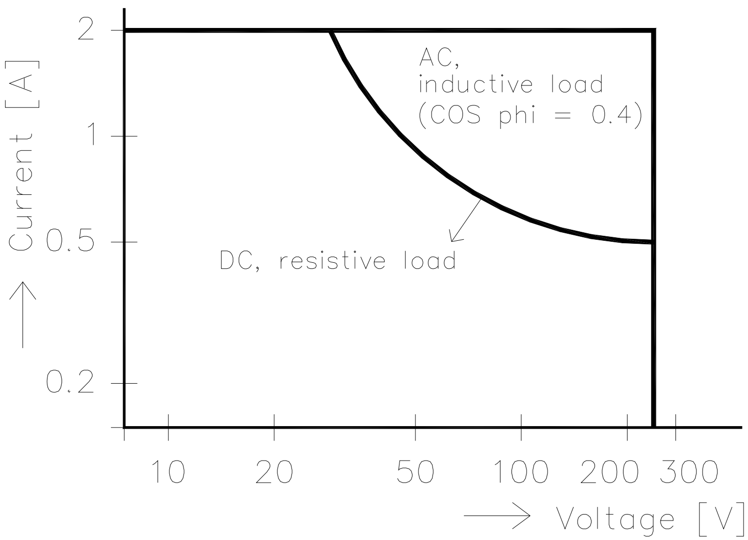
General	Type number[1]:	FS-TSRO-08UNI
		FC-TSRO-08UNI
	Approvals:	CE; UL, CSA; TUV pending
	Safety class:	up to SIL3
Input	Nominal input voltage:	24 Vdc
	Max. input voltage:	36 Vdc
	Relay pick-up voltage:	19.2 Vdc
	Input current:	Typically 40 mA at 24 Vdc
Output	Number of output channels:	8
	Max. output current:	2 A (fused)
	Min. output current:	1 mA at 5 V
	Max. output voltage:	250 Vac / 250 Vdc
	Max. switched load:	500 VA / 150 W (see Figure 403 on page 650)
Fuses	Rating:	2 AT (slow-acting)
	Dimensions:	5 × 20 mm (0.2 × 0.78 in)
Physical	Module dimensions:	274 × 109 × 71mm (L × W × H) 10.8 × 4.3 × 2.8 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	275 mm (10.8 in)
Termination	Channel screw terminals:	
	• Max. wire diameter:	2.5 mm² (AWG 14)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
	External power screw terminals:	
	• Max. wire diameter:	16 mm² (AWG 8)
	• Strip length:	7 mm (0.28 in)
	• Tightening torque	1.2 Nm (0.88 ft.-lb.)
Environment	Ambient temperature:	–5°C—+60°C (23°F—140°F)

Isolation	Isolation:	
	• Coil to contact	3750 Vac
	• Contact to contact	1200 Vac
Relay contact	Max. switching load[2]:	250 Vac, 2A 24 Vdc, 2A 48 Vdc, 1A 110 Vdc, 500 mA
	Max. switching frequency:	20 Hz
	Expected life:	See Figure 401 on page 647.
	Contact material:	gold flash over silver alloy

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 When switching DC loads, only use resistive loads or inductive loads with spark suppression diodes

Figure 403 Maximum switched power



TRO-0824

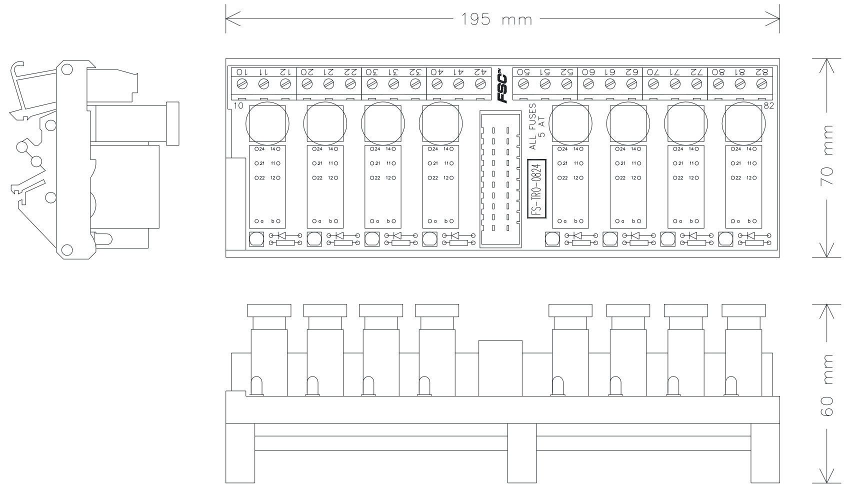
Non-safe dry digital output FTA (8 channels, NO/NC)

Description

Field termination assembly module TRO-0824 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). It has eight non-safe potential-free relay changeover contacts (NO/NC). The energized relay state is indicated by a LED on the module. You can connect up to eight channels to TRO-0824 via the system interconnection cable SICC-0001/Lx. This cable is plugged into the SIC connector on the FTA module, and connects to a (redundant pair of) SDO-0824 module(s).

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

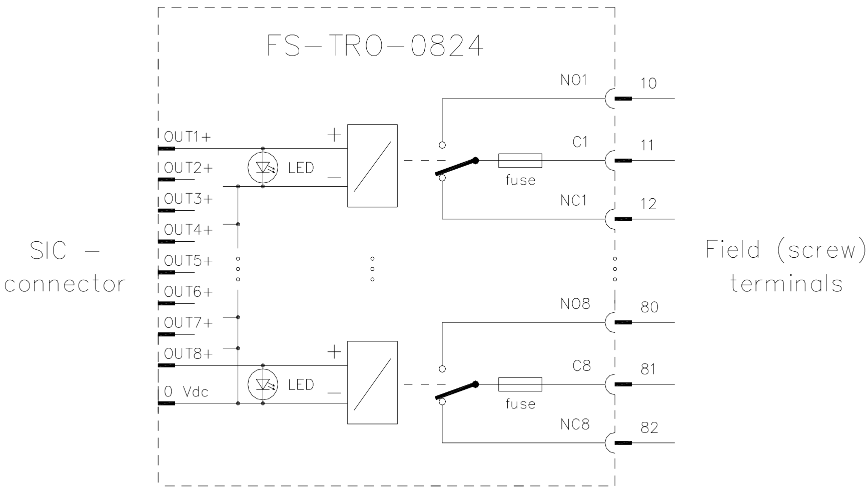
Figure 404 Mechanical layout



Each channel consists of:

- One relay
- A changeover contact with a fused (5 AT) common
- A status indicator LED

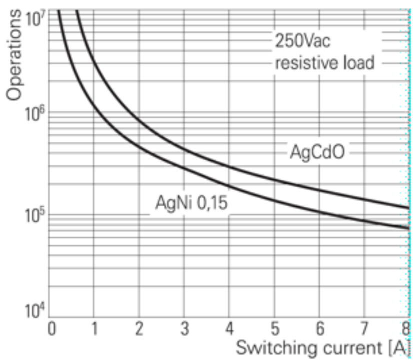
Figure 405 Schematic diagram



Relay life

The electrical life of the relays heavily depends on the contact rating the relay is exposed to. Figure 406 on page 652 shows the expected relay life versus contact current.

Figure 406 Life curve of the applied relays



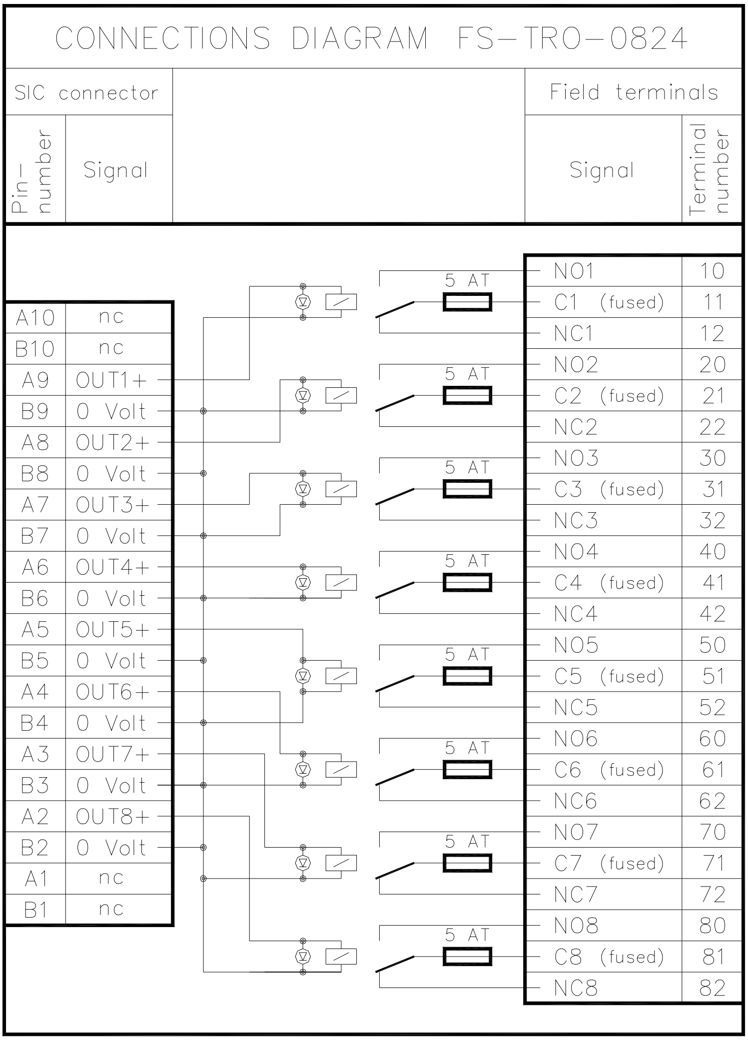
Applications

For details on applications and connection options for TRO-0824, see "SICC-0001/Lx" on page 715.

Connections

The connections diagram of the TRO-0824 module:

Figure 407 Connections diagram



Technical data

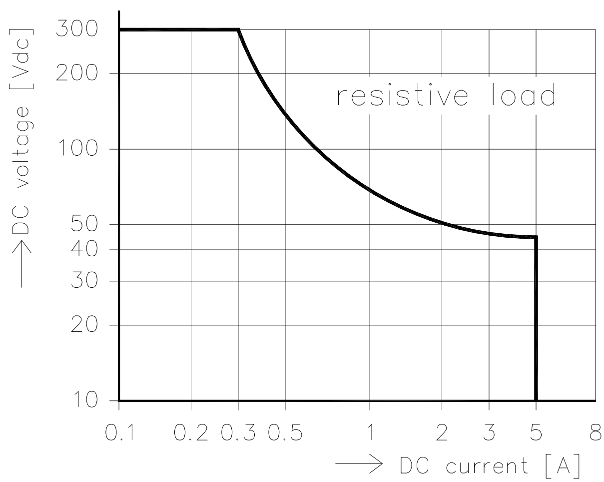
The TRO-0824 module has the following specifications:

General	Type numbers[1] :	FS-TRO-0824
		FC-TRO-0824
	Approvals:	CE, UL, TUV, CSA
Input	Nominal input voltage:	24 Vdc
	Max. input voltage:	31 Vdc
	Relay cut-in voltage:	19 Vdc
	Input current:	typically 27 mA at 24 Vdc
Output	Number of output channels:	8
	Max. output current:	5 A
	Max. output voltage:	250 Vac / 300 Vdc
	Max. switched load:	1250 VA / 150 W at 30 Vdc (see Figure 408 on page 655)
Fuses	Rating:	5 AT (slow-acting)
	Dimensions	5 × 20 mm (0.20 × 0.79 in)
Physical	Module dimensions:	195 × 70 × 60 mm (L × W × H) 7.68 × 2.76 × 2.36 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	196 mm (7.72 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

Relay contacts	Max. current:	8 A
	Max. switched voltage:	250 Vac / 300 Vdc
	Max. switched load:	2000 VA / 192 W at 24 Vdc (see Figure 408 on page 655)
	Max. switching frequency:	20 Hz
	Expected life:	See Figure 406 on page 652
	Isolation:	
	• Coil to contact	4000 Vac
	• Contact to contact	1000 Vac
	Ambient temperature:	–40°C—+70°C (–40°F—+158°F)
	Contact material:	Silver-cadmium oxide (AgCdO)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

Figure 408 Maximum DC switched power curve for TRO-0824 module



TRO-1024

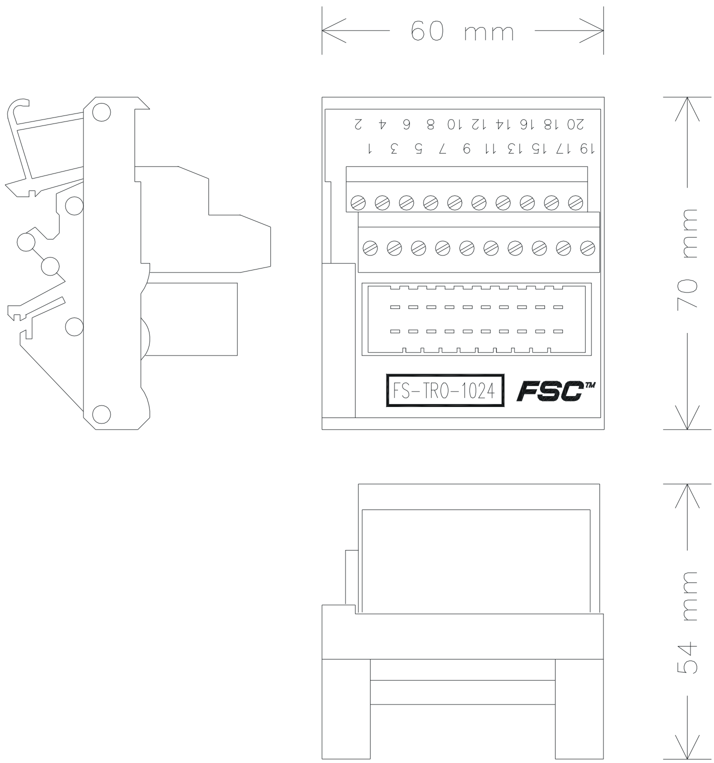
Non-safe dry digital output (relay contact) FTA (10 channels)

Description

Field termination assembly module TRO-1024 is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The non-safe channels of a (redundant pair of) RO-1024 module(s) can be connected to the TRO-1024 module via the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 409 Mechanical layout



Applications

For details on applications and connection options for TRO-1024, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TRO-1024 module:

Figure 410 Connections diagram

CONNECTIONS DIAGRAM FS–TRO–1024

SIC connector		Field terminals	
Pin–number	Signal	Signal	Terminal number
A10	C1	C1	1
B10	NO1	NO1	2
A9	C2	C2	3
B9	NO2	NO2	4
A8	C3	C3	5
B8	NO3	NO3	6
A7	C4	C4	7
B7	NO4	NO4	8
A6	C5	C5	9
B6	NO5	NO5	10
A5	C6	C6	11
B5	NO6	NO6	12
A4	C7	C7	13
B4	NO7	NO7	14
A3	C8	C8	15
B3	NO8	NO8	16
A2	C9	C9	17
B2	NO9	NO9	18
A1	C10	C10	19
B1	NO10	NO10	20

Technical data

The TRO-1024 module has the following specifications:

General	Type numbers[1] :	FS-TRO-1024
		FC-TRO-1024
	Approvals:	CE, UL, TUV, CSA
Power	Number of channels:	10
	Maximum voltage:	48 Vac / 48Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum switched power:	100 W / 1000 VA
	Maximum continuous current per channel:	2 A
	Contact material on RO-1024:	Gold flush silver-cadmium oxide
Physical	Module dimensions:	60 × 70 × 54 mm (L × W × H) 2.36 × 2.76 × 2.13 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	61 mm (2.40 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSAO-0220m

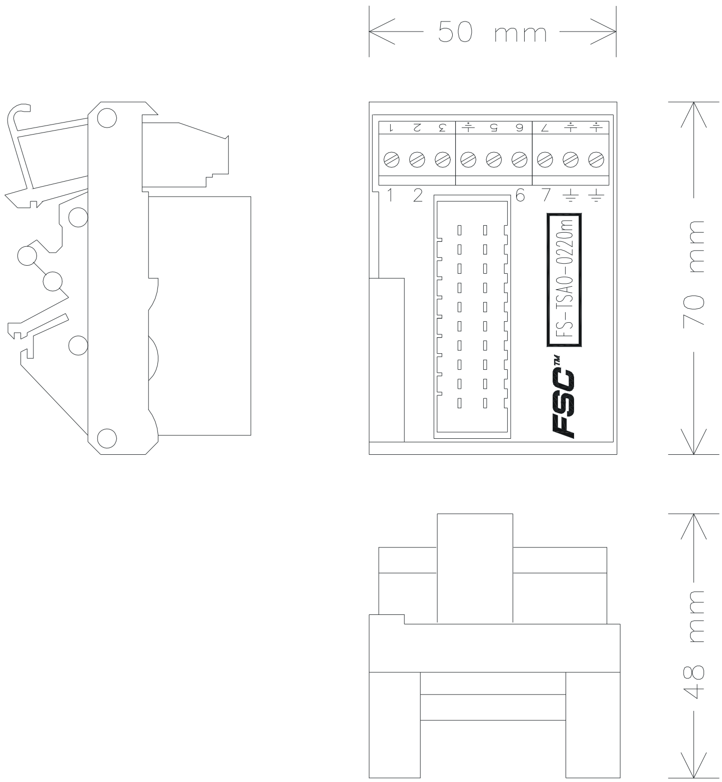
Safe analog output FTA (0(4)-20 mA, 2 channels)

Description

Field termination assembly module TSAO-0220m is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The two channels of an TSAO-0220m module can be connected to a (redundant pair of) SAO-0220m module(s) with the system interconnection cable SICC-0001/Lx.

The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for connecting field wiring.

Figure 411 Mechanical layout



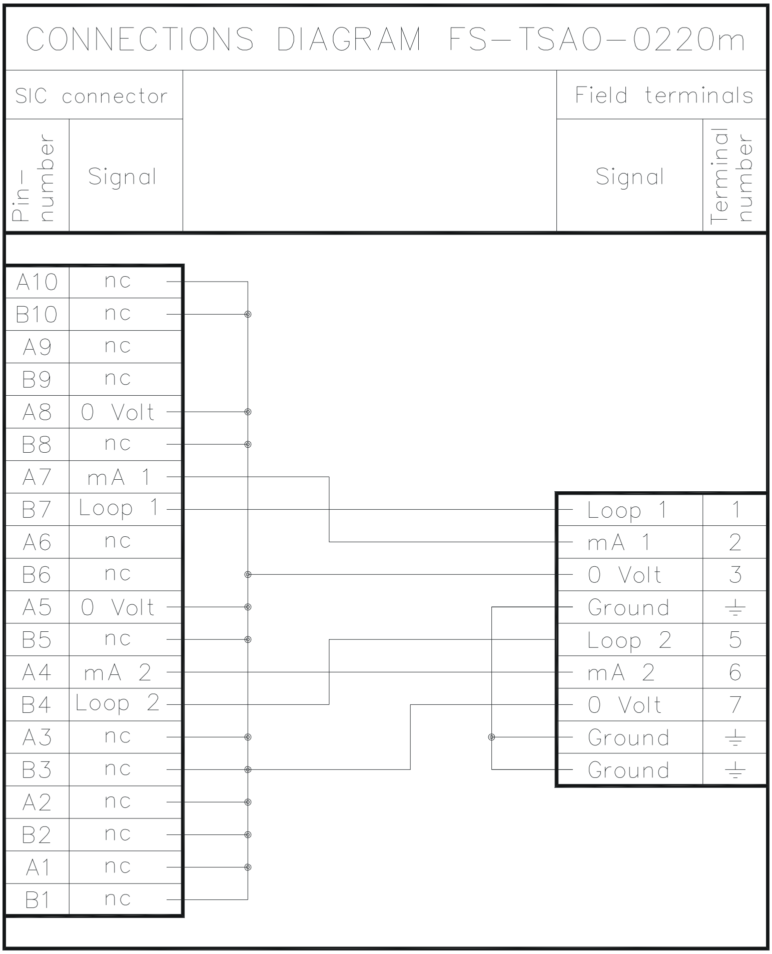
Applications

For details on applications and connection options for TSAO-0220m, see “SICC-0001/Lx” on page 715.

Connections

The connections diagram of the TSAO-0220m module is as follows:

Figure 412 Connections diagram



Technical data

The TSAO-0220m module has the following specifications:

General	Type numbers[1] :	FS-TSAO-0220m
		FC-TSAO-0220m
	Approvals:	CE, TUV, UL, CSA, FM
Power	Number of channels:	2
	Maximum voltage:	40 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	25 mA
Physical	Module dimensions:	50 × 70 × 48 mm (LxWxH) 1.97 × 2.76 × 1.89 in (LxWxH)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	51 mm (2.01 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

TSAOH-0220m

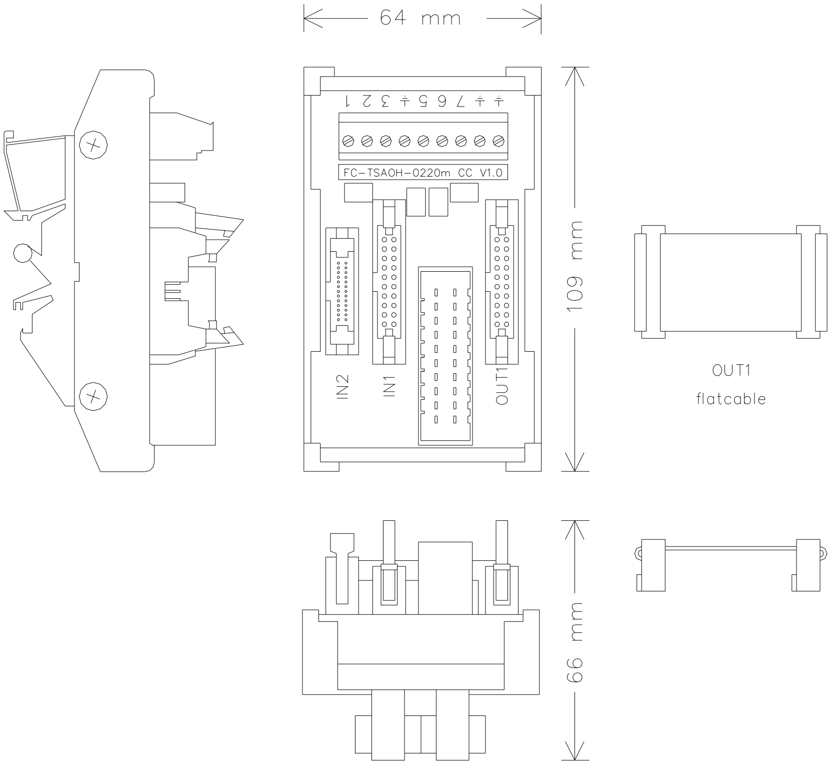
Safe analog output FTA with HART interface (0-20mA, 2 channels)

Description

The field termination assembly module TSAOH-0220m is the interface between system interconnection cable SICC-0001/Lx and external field wiring (screw terminals). The two analog output channels of a (redundant pair of) SAO-0220m module(s) can be connected to the TSAOH-0220m with the system interconnection cable SICC-0001/Lx.

The TSAOH-0220m module provides a HART interface on each channel *and* enables connection of -up to eight- TSAOH-0220m modules in series, enabling the use of all 16 HART channels of the HART-multiplexer.

Figure 413 Mechanical layout



The FTA module has a universal snap-in provision for standard DIN EN rails, and screw terminals for the connection of field wiring.

HART interface

Warning:

Suggested HART multiplexers have *no* galvanic isolation between (24 Vdc) supply and the HART signals (common 0 Vdc).

The TSAOH-0220m module provides an interface to HART multiplexer units from MTL and Pepperl+Fuchs (P+F). Dedicated connectors are installed on the FTA to enable the use of the standard cables from these suppliers.

The following equipment can be connected:

	MTL Solution	**P+F solution**
Multiplexer unit	MTL4842	KFD0-HMS-16 or KFD2-HMM-16
Cable	MTL FLAT20-2.2	K-MH26
Connector on FTA[1]	IN1	IN2

1 See Figure 413 on page 662

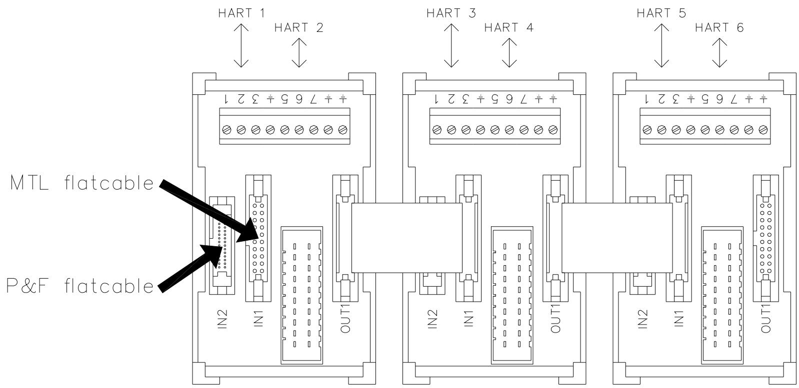
HART-flatcable linking

The flatcable connector OUT1 in Figure 413 on page 662 allows linking of up to eight TSAOH-0220m modules in series.

Figure 414 on page 664 shows how the flatcable, supplied with each TSAOH-0220m, can be used to link OUT1 with IN1 of the next module:

This way the outputs of the first TSAOH-0220m module will be connected to channel 1 and 2 of the HART-multiplexer on connector IN1 or IN2, the second module to channel 3 and 4, the third module to channel 5 and 6, and so on.

Figure 414 Linking up to 16 HART channels to one multiplexer unit



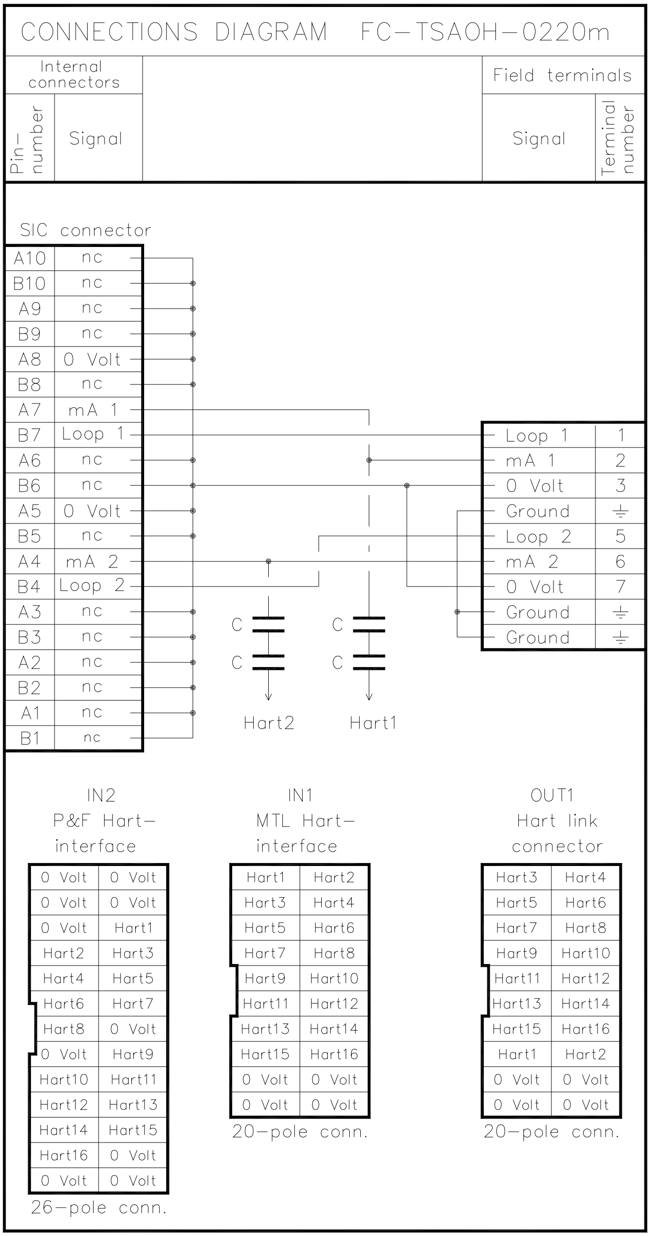
Applications

For details on applications and connection options for the TSAOH-0220m, see “SICC-0001/Lx” on page 715.

Connections

Figure 415 on page 665 shows the connections diagram of the TSAOH-0220m.

Figure 415 Connections diagram



Technical data

The TSAOH-0220m module has the following specifications:

General	Type numbers[1] :	FC-TSAOH-0220m CC V1.0
	Approvals:	CE; TUV, UL and CSA pending
Power	Number of channels:	2 (with common 0V)
	Maximum voltage:	40 Vdc – IEC 1010 (1990), overvoltage category 3 (Table D.12)
	Maximum continuous current per channel:	25 mA
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft.-lb.)
Physical	Module dimensions:	64 × 109× 66 mm (LxWxH) 2.52 x 4.29 x 2.60 in (LxWxH)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	65 mm (2.56 in)

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

TPSU-2430

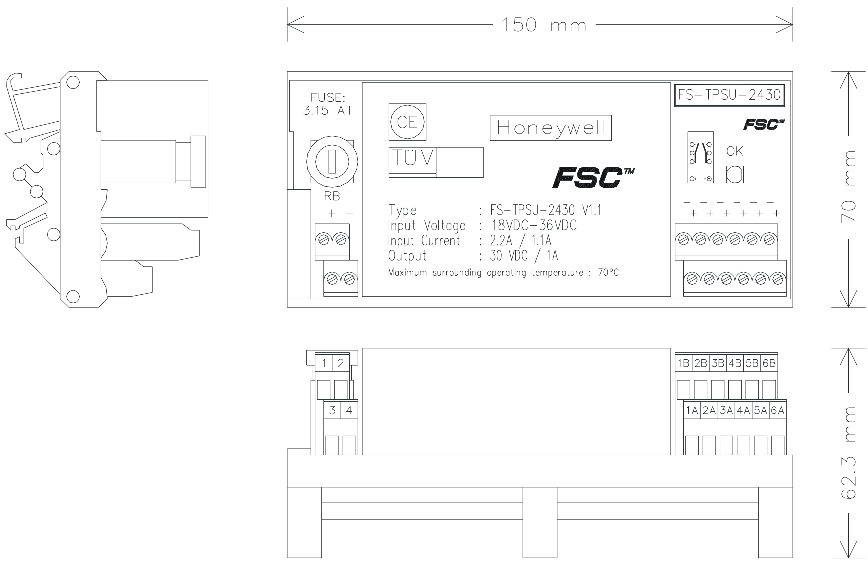
24 Vdc to 30 Vdc / 1 A converter

Description

The TPSU-2430 module is a DC/DC converter, which provides an isolated 30 Vdc / 1 A to other field termination assemblies (FTAs), such as the analog input FTA modules TSAI-1620m and TSHART-1620m. It has voltage monitoring capabilities with local LED indication and also provides alarm functions (read back relay contact). If the local DC/DC output voltage is OK, the LED is on and the read back relay contact is closed.

The FTA module has a universal snap-in provision for standard DIN-EN rails.

Figure 416 Mechanical layout



Connections

The TPSU-2430 module has four screw terminals for connecting incoming power wires and the read back wiring. The screw terminals are numbered 1 to 4. The function of each terminal is listed below:

Screw terminal	Function
1	Read back contact
2	Read back contact
3	24 Vdc IN +
4	24 Vdc IN –

Caution

Removal or connection of the 24 Vdc IN+ and/or 24 Vdc IN– wire(s) is only allowed when the 24 Vdc power supply to the TPSU-2430 module has been switched off.

The TPSU-2430 module has twelve screw terminals for connection of outgoing power wires. The screw terminals are numbered ‘1A’, ‘1B’, ‘2A’, and so on, up to ‘6B’. The function of each terminal is listed below:

Screw terminal	Function
1A	30 Vdc OUT
1B	0 Vdc OUT
2A	30 Vdc OUT
2B	0 Vdc OUT
3A	30 Vdc OUT
3B	0 Vdc OUT
4A	30 Vdc OUT
4B	0 Vdc OUT
5A	30 Vdc OUT
5B	0 Vdc OUT
6A	30 Vdc OUT
6B	0 Vdc OUT or ground [1]

1 O Vdc must be grounded to provide a predictable system response in case of a short to earth in the field.

Technical data

The TPSU-2430 module has the following specifications:

General	Type numbers[1 2]:	FS-TPSU-2430 V1.1
		FC-TPSU-2430 CCV1.1
	Approvals:	CE, TUV, UL, CSA, FM
	Safety class:	up to and including SIL3
	MTBF:	approx. 400,000 hours
Input	Nominal input voltage:	24 Vdc
	Input voltage range:	18—36 Vdc
	Inrush current:	≤ 4 A *(see note below)*
Output	Output voltage:	30 Vdc, ± 0.25 V
	Output current:	1 A (short-circuit proof)
	Short-circuit current:	< 3.3 A
	Ripple (0—30 MHz):	< 0.1 Vrms
	Regulation:	< 1% (load + line)
	Transient response:	class C according to NFC42801C
	Power-on overshoot:	output < 31 V
	Overvoltage protection:	31 V
	Long-term stability (after 30 min. operation):	< 0.3%
	Efficiency:	> 75%
	Switching frequency:	> 25 kHz
Physical	Module dimensions:	150 × 70 × 62.3 mm (L × W × H) 5.91 × 2.76 × 2.45 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	151 mm (5.94 in)
Fuse	Rating:	3.15 AT (slow-acting)
	Dimensions:	5 × 20 mm (0.2 × 0.79 in)
Termination	Screw terminals:	
	• Max. wire diameter	2.5 mm² (AWG 14)
	• Strip length	7 mm (0.28 in)
	• Tightening torque	0.5 Nm (0.37 ft-lb)

Isolation	Isolation voltage:	
	• Input to output	2000 Vac (1 min.)
	• Input to relay contact	2000 Vac (1 min.)
	• Output to relay contact	2000 Vac (1 min.)
Environment	Operating temperature:	–5°C—+70°C (23°F—158°F)
	Storage temperature:	–40°C—+85°C (–40°F—+185°F)
	Cooling:	natural convection
Alarm functions	Overvoltage protection:	dual, two-fault-tolerant
	Restart overvoltage protection:	only after removal of 24 Vdc power
	Undervoltage detector:	LED on if voltage OK, read-back relay contact closed if voltage OK
	Undervoltage level:	typically 27.5 Vdc
Readback	Relay contact rating:	36 Vdc / 40 mA, 30 Vac / 40 mA

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

2 Modules with suffix code V1.1 or CCV1.1 have reduced power dissipation. There are no functional changes.

⚠ **Caution**

The inrush current limiter is only active at power-on.

To regain the inrush current limiting function, the TPSU-2430 module must be switched off for at least 30 seconds. Switching on the module within 30 seconds may blow a fuse or activate a circuit breaker.

TSPKUNI-1624

Sub-D to Powered Knife terminals FTA (Universal,16ch)

Description

The field termination assembly module TSPKUNI-1624 provides sixteen sets of three knife terminals for RUSIO signals.

The TSPKUNI-1624 has:

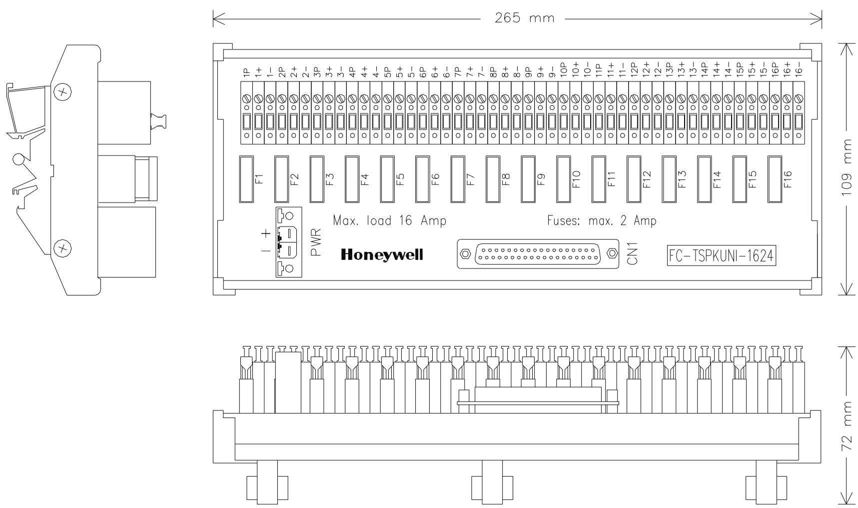
- a Power input connector (PWR) that supplies the (+24Vdc) field power
- 37-pole sub-D male connector (CN1) that must be connected with (16) RUSIO channels
- 16 sets of three knife terminals for the sixteen channels

Each channel has a the following knife terminal connections:

- a P terminal that has a (2 Amp) fused +24Vdc connection.
- a + terminal that is the (RUSIO) signal connection.
- a - terminal that is the common 0 Volt connection.

The TSPKUNI-1624 has universal snap-in provisions for standard DIN EN rails.

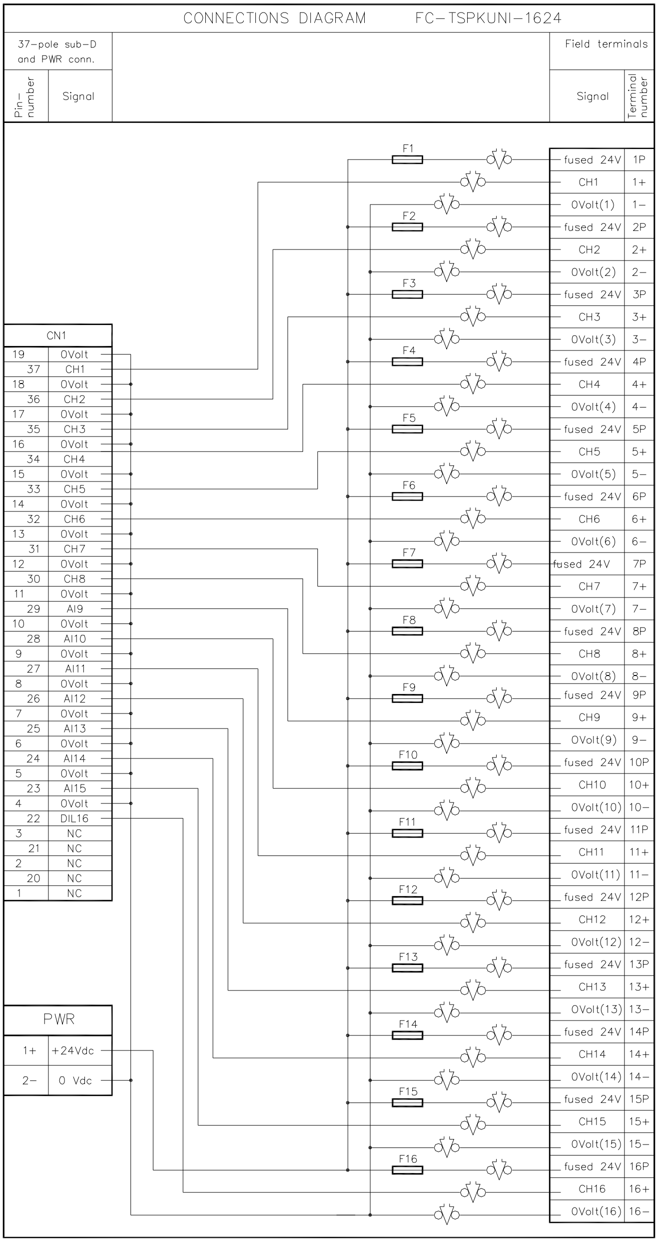
Figure 417 Mechanical layout



Connections

The connection diagram of the TSPKUNI-1624 module is as follows:

Figure 418 Connections diagram



The TSPKUNI-1624 must be combined with 16 channels of a (redundant set of) universal IO module(s).
A cable[2] of suitable lenght is used to connect the TSPKUNI-1624 with an (redundant or non-redundant) IOTA.

External power

A 24 Vdc power distribution cable (see datasheet "PDC-MB24-y" on page 814 for details) can be used to connect the main busbar with the power connector (PWR).

- When using other connection cables, make sure the wire size is adequate and the supplied Weidmuller BVZ 7.62HP/02/180F SN connector is used.

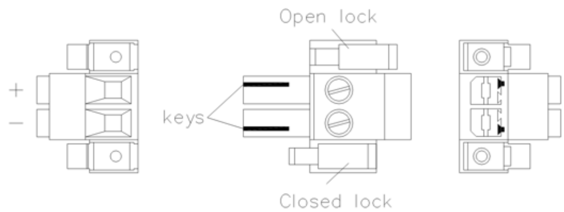
Note:

The 0 V connection of the external power is directly connected to the common 0 V of all output channels.

Figure 419 on page 673 shows the top, side & bottom view and the pin assignment of the power input connector.

- The pin marked **+** is pin 1: connected to +24Vdc busbar.
- The pin marked **-** is pin 2: connected to the 0Vdc busbar.

Figure 419 Power input connector (Weidmuller BVZ 7.62HP/02/180F SN) top, side and bottom view



The two (red) locking slides of the cable-connector in Figure 419 on page 673 keep the cable-connector locked when inserted into the power connector (PWR).

2. Honeywell type numbers that are available: 4213509 up to and including 4212516.
These type numbers correspond with part number CA-HWC300-AIO-DIO-xxM (Pepperl & Fuchs), where 'xx' stands for the length in meters.
For details see the manufacturer's data sheet (Pepperl & Fuchs).

Technical data

The TSPKUNI-1624 module has the following specifications:

General	Type numbers[1]:	FC-TSPKUNI-1624
	Approvals:	CE; TUV, UL, CSA pending
Power	Field power:	24 Vdc
	Total field load:	max 16 Amp
	Fuse:	
	• rating:	2 Amp, 58V
	• type:	TAC ATO Style Blade Fuse
	• manufacturer:	Littelfuse
	• ordernumber:	142.6185.420_
Physical	Module dimensions:	265 x 109 x 72 mm (L x W x H) 10.44 x 4.29 x 2.84 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	266 mm (10.47 in)
Termination	Channel screw terminals: • wire diameter • strip length • tightening torque	 0.2 - 4 mm^2 (AWG 28 - AWG 12) 8 mm (0.31 in) max. 0.6 Nm (0.44 ft-lb)
	Power connector: • make and type: • strip length: • Connectable conductors:	 Weidmuller: BVZ 7.62HP/02/180F SN (conn.) Weidmuller: BV/SV7.62HP KO (keys) 8 mm (0.28 in) 0.5-6mm^2 (AWG 20-AWG 10)

1 FC-type modules are conformal coated modules.

DCOM-232/485

RS232/485 communication FTA

Description

The communication FTA DCOM-232/485 is the combined RS232/485 communication interface of Safety Manager. It is used to provide Safety Manager with a RS485/422 or a RS232 connection.

The communication FTA may be driven by one (or a pair of redundant) Control Processor(s). The communication FTA does not require separate supply wiring. It is supplied by the connected Control Processor(s). The communication FTA must be connected with earth (use the supplied terminal). This will connect the shield of the internal cable(s) and the housing of the field connector(s) with (cabinet-) earth. For information on required communication cables, see section “Communication cables” on page 735.

The module has a universal snap-in provision for standard DIN EN rails.

Figure 420 Top view of the DCOM-232/485 communication FTA

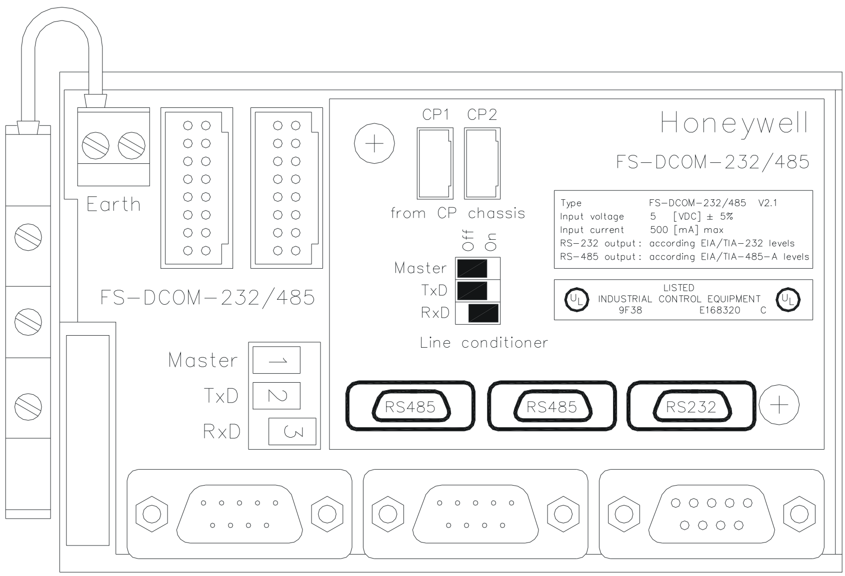
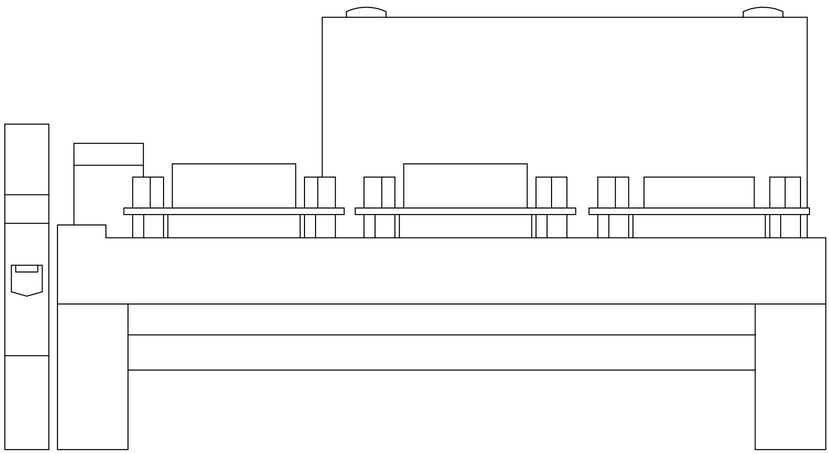


Figure 421 Front view of the DCOM-232/485 communication FTA



Connectors

Table 75 on page 676 describes the connectors present on the DCOM-232/485.

Table 75 connections for the DCOM-232/485

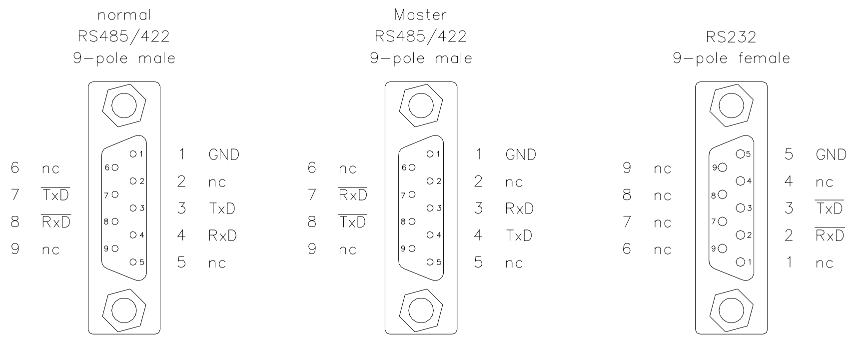
Connector	Quantity	Description	Use with cable
2-pin earth connector	1	FTA connection to cabinet earth (see Figure 420 on page 675).	-
2-pin earth terminal		1 FTA connection to cabinet earth	Supplied
9pole sub-D male	2	Used for RS422 or RS485 communication. The two connectors are identical: if only one is used, then the other needs an end of line terminator.	CCE-485-01/Lx CCE-485-02/Lx EOL-485-01
9pole sub-D female	1	Used for RS232 communication.	CCE-232-01/Lx CCE-232-02/Lx
16-pins male	2	Communication and supply connection to the Control Processor(s).	CCI-UNI-01

Pin allocation

Figure 422 on page 677 shows the pin allocation of the RS232 and RS485 connectors on the DCOM-232/485 communication FTA.

- The RS485/422 connectors are male type connectors.
- The RS232 connector is a female type connector.
- The pin assignment for the RS485/422 connectors depends on the position of the “Master” switch (dip switch 1).

Figure 422 Pin allocation of the connectors on the DCOM-232/485[1]



1 Figure 420 on page 675 shows the physical location of these connectors.

Dip switches

The DCOM-232/485 contains three color-coded dip switches for configuration of the external RS485/422 communication lines.

Line conditioner

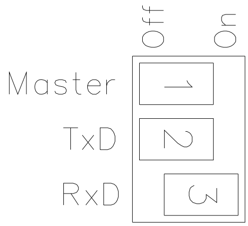
A line conditioner consists of a pull-up and a pull-down resistor of 680 Ω each.

Line conditioners are connected to the RxD lines if switch 2 and/or 3 are `ON`. With these resistors connected, the receivers will get less noise during the periods in which no transmitter is active on the line.

Dip switch settings

Figure 423 on page 678 and Table 76 on page 678 show the possible settings when configuring the DCOM-232/485.

Figure 423 Detail of the DCOM-232/485 dip switches



- Dip switch 1 (Master) selects the RS485/422 pin configuration.
  - The `Off` position is “normal”.
  - The `On` position changes the pin allocation of the RS485/422 connectors from “normal” to “master” (see figure 220).

  This switch makes it possible to use one-on-one cables only (see e.g. “CCE-485-01/Lx” on page 753). In case of a communication-master re configuration, no new cabling is required (provided only one-on-one cables are used).
- Dip switch 2 (TxD) is the line conditioner for the transmitter lines (on pins 3 and 7).
- Dip switch 3 (RxD) is the line conditioner for the receiver lines (on pins 4 and 8).

Table 76 dip switch settings for the DCOM-232/485[1]

DCOM-232/485 Configuration	Dip switch 1	Dip switch 2	Dip switch 3
RS422 Point-to-point	`On/Off`[2]	`On`	`On`
RS485 Slave	`Off`	`Off`	`Off`
RS485 Master	`On`	`On`	`On`
RS485 Master half duplex	`On`	`On`	`Off`
RS232 Point-to-point	`Off`	`Off`	`On`

1 `On` and `Off` positions are marked on the actual module (see Figure 420 on page 675).

2 When using standard one-on-one cables (e.g. cable “CCE-485-01/Lx” on page 753), dip switch 1 of the DCOM-232/485 on one side must be `On` and dip switch 1 of the other DCOM-232/485 must be `Off`.
When using a cross-cable, dip switch 1 of both DCOM-232/485s must be `Off`.

Note:

For proper RS232 operation, it is important that dip switch 3 is `On`!

Cable lengths

The maximum (total) cable length for RS232, RS422 and RS485 communication depends on the baud rate and the communication method (full-duplex or half-duplex).

Table 77 on page 679 gives the maximum cable length provided a proper cable type is used.

Table 77 Maximum cable length versus baud rate

communication method	baud rate	maximum cable length
RS232 full-duplex	≤ 100 kBd	10 m
RS422 full-duplex RS485 full-duplex	≤ 100 kBd	1.2 km
	≤ 125 kBd	1 km
	≤ 1 MBd	120 m
	≤ 2 MBd	60 m
RS485 half-duplex	≤ 100 kBd	600 m
	≤ 125 kBd	500 m
	≤ 1 MBd	60 m
	≤ 2 MBd	30 m

Fan-in / fan-out

- RS232 connections are point to point only
- RS422 connections are point to point only
- RS485 full duplex connections allow maximum 32 connected devices
- RS485 half duplex connections allow maximum 16 connected devices

Technical data

General	Type number[1 2]:	FS-DCOM-232/485 V2.1
		FC-DCOM-232/485 V2.1
	Approvals:	CE, TUV, UL, FM
Physical	Module dimensions:	110 × 70 × 61 mm (L × W × H) 4.33 × 2.76 × 2.40 in (L × W × H)
	Terminal dimensions:	6 × 57 × 47 mm (L × W × H) 0.24 × 2.24 × 1.85 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	117 mm (4.6 in)
Power	Input voltage:	5 Vdc ±5%
	Input current:	Max 500 mA, supplied by the Control Processor(s)
Output	RS232 output:	According EIA/TIA-232 levels
	RS232 baudrate:	0—250 kBaud
	RS485/422 output:	According EIA/TIA-485-A levels
	RS485/422 baudrate:	0—2 MBaud (transparent, FM0, FM1 or Manchester coded)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

2 Model numbers prior to V2.0 do not have a `MASTER` switch as indicated in Figure 423 on page 678
Model number V2.1 has modified circuits. They solve the issue with model number V2.0 to cause line faults in unusual (rare) RS232 configurations when DIP switch 2 (TxD) is set `On`.
Please note that V2.0 does not support multidrop SafeNet.

SDW-550 EC

5 port HSE communication FTA or "switch"

Tip:

This data sheet contains an extract of the SDW-550 EC manufacturer specifications. For further information see the SDW-500 product documentation issued by Westermo.

Description

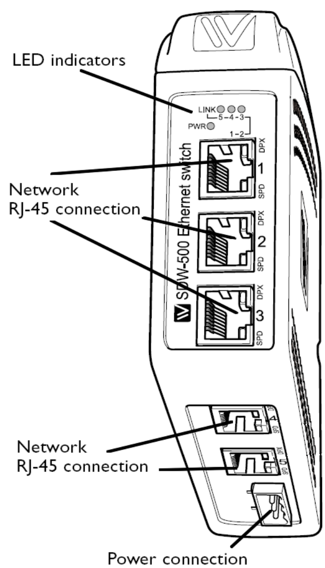
The SDW-550 EC, make Westermo, is a five port 10/100Base Ethernet switch used as interface between USI-0001 or USI-0002 communication modules in the Control Processor and the field.

Figure 424 on page 681 shows that the SDW-550 EC has one (24Vdc) power connector and five isolated RJ-45 TX port connectors, divided into two sections.

The raised isolation level between the two port sections makes the SDW-550-EC compliant to the IEC 61010.

For IEC 61010 compliance use one section (e.g. ports 1, 2 and 3) must be connected to the field while the other section (ports 4 and 5) must connect to the CP backplane, thus optimizing power surge protection from the field.

Figure 424 SDW-550 EC connections



It is recommended to keep port 1 available for a (portable) Safety Station. (See Figure 428 on page 686 for details.)

Mounting

The SDW550 EC is to be mounted on a horizontally placed TS-35 rail.

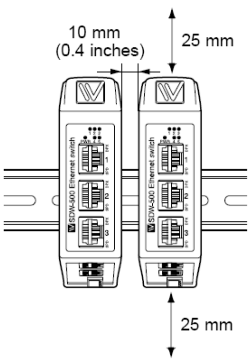
Warning:

Westermo SDW-500 series modules have to be clamped on a *horizontally mounted* TS-35 rail, with free airflow around the module:

- at least 25mm (1.0 inch) above and below the module and
- at least 10mm (0.4 inch) left and right of the module.

Figure 425 on page 682 shows the mounting instructions of the SDW 500 series switches.

Figure 425 Mounting instructions SDW-500 series switches



DIP switch settings

Warnings:

1. Do not open connected equipment.
2. Prevent damage to internal electronics by first discharging your body to ground (e.g. use an ESD wrist strap) before removing the lid on top of the unit.
3. Prevent access to hazardous voltage by disconnecting the unit from 24V supply and removing *at least* the RJ45 field connections (port 1 thru 3).

The DIP switches of the SDW-550 EC are located under the lid on top of the unit. Figure 426 on page 683 shows how to access the DIP switches.

Figure 426 Lid removal to access DIP switches

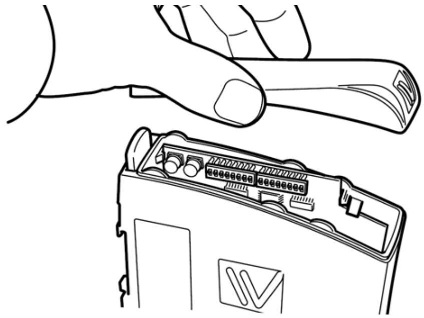


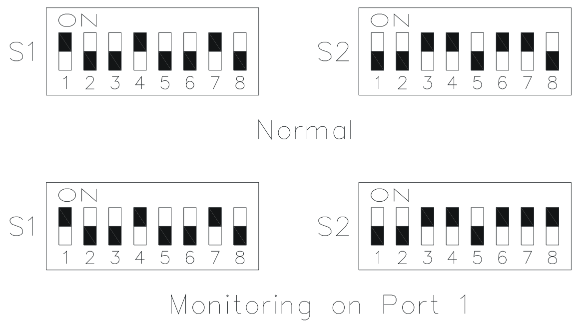
Figure 427 on page 683 shows the advised switch settings:

- The top half of the figure shows the normal settings for operation with Safety Manager.
- The bottom half of the figure shows the switch settings when port 1 is to be configured as monitor. When configured as monitor all packets throught the switch are mirrored to port 1 (e.g. to connect a Safety Station).

Notes:

1. Neither setting in Figure 427 on page 683 is the factory default setting!
2. The DIP switch configuration settings are only read during power-up.

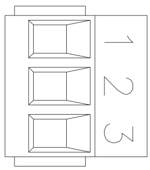
Figure 427 Advised DIP switch settings



Power

Each SDW-550 EC needs 24 Vdc power and an Earth connection.

The Earth connection wire must be 1 mm^2 (AWG 17) copper or more. The power wires must be $0.5mm^2$ (AWG 20) copper or more.

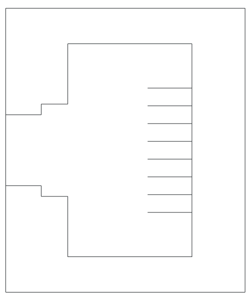


Pin	Description
1	0 Volt
2	24 Volt
3	Earth

RJ-45 TX port connector

The RJ-45 TX port connectors of the SDW-550 EC module are shielded and equipped with status LEDs. For LED details see “Status LEDs” on page 684.

Below table shows the pin assignment of the RJ-45 TX connectors.



Contact	Signal	Direction	Description
1	TD+	Out/In	Transmitted/Received data
2	TD-	Out/In	Transmitted/Received data
3	RD+	In/Out	Received/Transmitted data
4	-		
5	-		
6	RD-	In/Out	Received/Transmitted data
7	-		
8	-		
Case	Shield		HF-connection to earth

Status LEDs

The SDW-550 EC has the following LEDs on the module front:

- a PWR (power) LED
- five LINK LEDs

The SDW-550 EC has the following LEDs on each RJ-45 TX port connector:

- a SPD (speed) LED
- a DPX (duplex) LED

Table 78 on page 685 describes the indications of the status LEDs.

Table 78 Status LEDS of the SDW-550 EC rail mounted switch

Module front status LEDs		
LED	**status**	**description**
PWR	ON Slow flashing Fast flashing	Internal power, initialization OK Initialization progressing Initialization error
LINK	OFF ON Flashing	No ethernet link Good ethernet link Ethernet traffic indication
Port connector status LEDs		
LED	**status**	**description**
SPD	OFF ON	10 Mbit/s (TX only) 100 Mbit/s (TX only)
DPX	OFF ON	Half duplex (TX only) Full duplex (TX only)

Applications

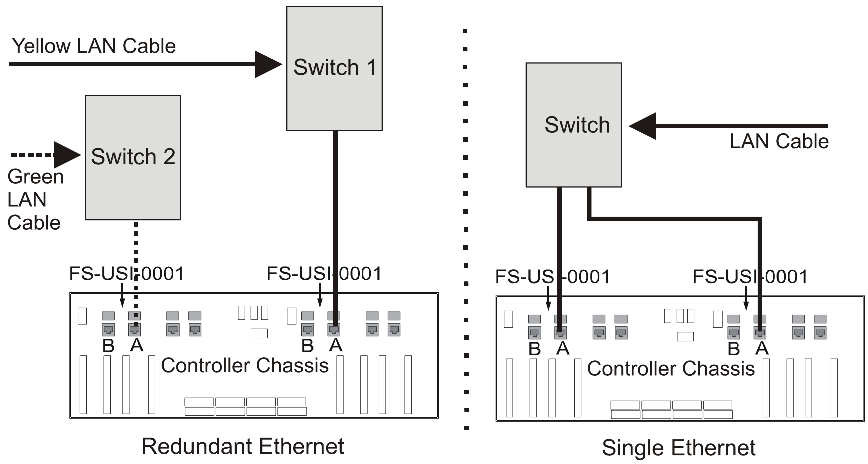
Ethernet switches are used in combination with the USI-0001 or USI-0002 communication modules to:

- provide galvanic isolation between Safety Manager and the network
- connect to other segments of the network.

Safety Manager with a redundant Controller contains up to four USI-0001 or USI-0002 communication modules, so up to eight ethernet channels may be present on the RJ-45 connectors of the Controller backplane (each USI-0001 or USI-0002 uses channel A and B for Ethernet communication).

Figure 428 on page 686 shows the basic configurations for connecting Ethernet switches to these channels.

Figure 428 Connecting the Ethernet switch to the USI-0001 communication modules and the LAN



Technical data

The SDW-550 EC has the following specifications:

General	Type number:	SDW-550 EC
	Manufacturer	Westermo
	Number of channels:	5
	Operating temperature:	–25°C— +70°C (–13°F— +158°F)
	Storage temperature:	–25°C— +70°C (–13°F— +158°F)
	Relative humidity:	5% to 95% (non-condensing)
	Approval:	CE, TUV, UL, FM
Power	Operating voltage:	DC 12 V—48V
	Rated current:	max. 320mA
	Power connector fuse:	Internal
Physical	Dimensions:	121 x 35 x 119 mm (D × W × H) 4.76 × 1.38 × 4.69 in (D × W × H)
	Weight:	0.2 kg
	Used rail length:	55 mm (35 + 2 x 10 free space) 2.18 in (1.38 + 2 x 0.4 free space)

MTL 24571

Single channel ethernet surge protector

Tip:

This data sheet contains an extract of a customized ZoneBarrier product issued by MTL Surge Technologies. For more information see the documentation provided by MTL Surge Technologies.

Description

The MTL 24571 (made by MTL Surge Technologies) is a single channel ethernet surge protector (100BaseT and 10BaseT).

When wired between an USI-0001 or USI-0002 communication module and the field, it gives the USI-0001 or USI-0002 and the Control Processor a IEC 61010 compliant protection against harmful voltages on the ethernet lines.

The MTL 24571 can be used for shielded twisted pair (STP) cables and in IEEE 802.3af compliant networks which apply 48V power on pins 1, 2, 3 and 6.

The MTL24571 has universal snap-in provisions for standard DIN EN rails.

Figure 429 Top-view and side-view of an MTL 24571

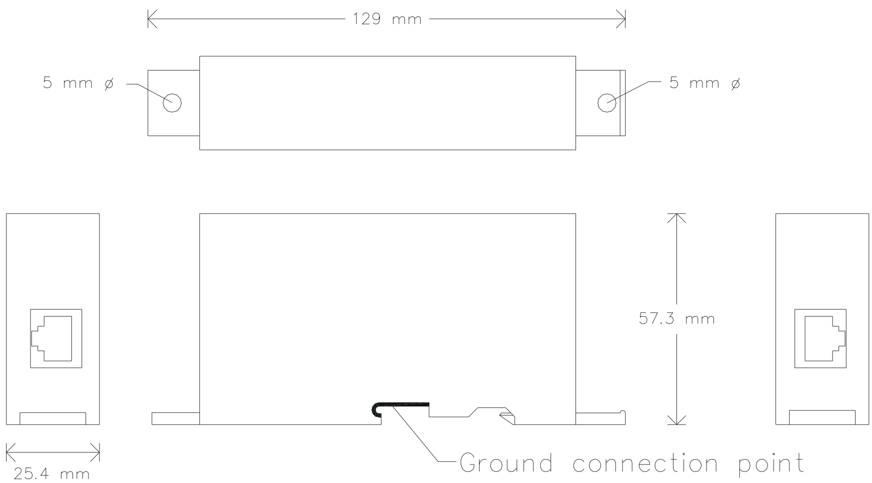
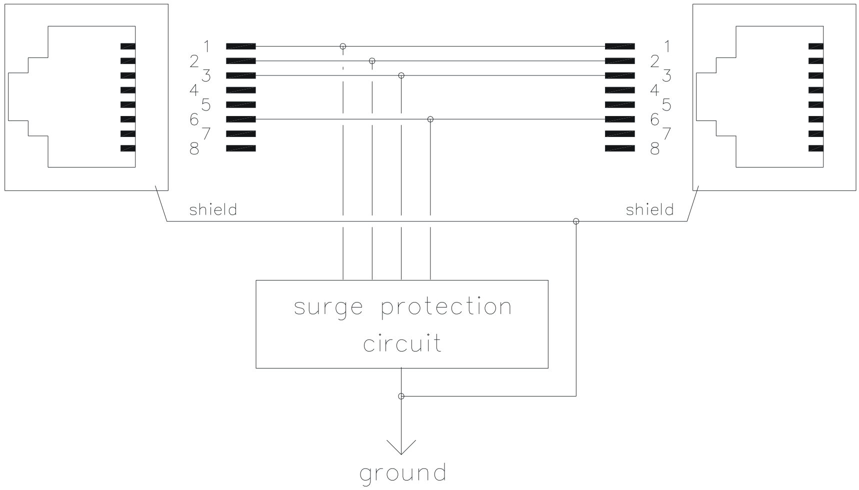


Figure 430 on page 688 provides a block diagram which shows the protected pins and that the shields of the RJ45 connectors are bonded to the protector ground.

Figure 430 Block diagram of the MTL 24571



Grounding

The MTL 24571 needs a proper connection to ground.

This can be achieved by grounding the DIN EN rail it is mounted on.

The MTL 24571 can also be mounted as a stand alone unit on a flat surface, (using the two 5 mm holes). In that case grounding must be done with a wire of (minimum) AWG 10 to the metal plate on the bottom of the MTL 24571 (using the self tapping screw provided).

Technical data

The MTL 24571 has the following specifications:

General	Type number:	MTL 24571
	Manufacturer:	MTL Surge Technologies
Approvals		CE, UL[1]
Power		none
Signals	Ethernet:	max. 155 MHz
	Attenuation:	max. -0.3 dB at 100 MHz
	PoE:	nominal 48 Vdc
	common mode:	230 Vac
Termination	RJ45:	shielded 4 wire (pins 1, 2, 3 and 6)
	Grounding:	DIN EN rail or minimum AWG 10
Protection	Surge Capacity:	1 kA per wire
	Residual Voltage:	75 V @ 0.5 kA, 8/20 µs
	Clamp voltage:	62 Vdc
Physical	Dimensions:	129 x 25.4 x 57.3 mm (D x W x H) 5.08 x 1.0 x 2.26 in (D x W x H)
	Weight:	0.09 kg
	Used rail length:	26 mm (1.02 in)

1 UL 497B, for indoor use

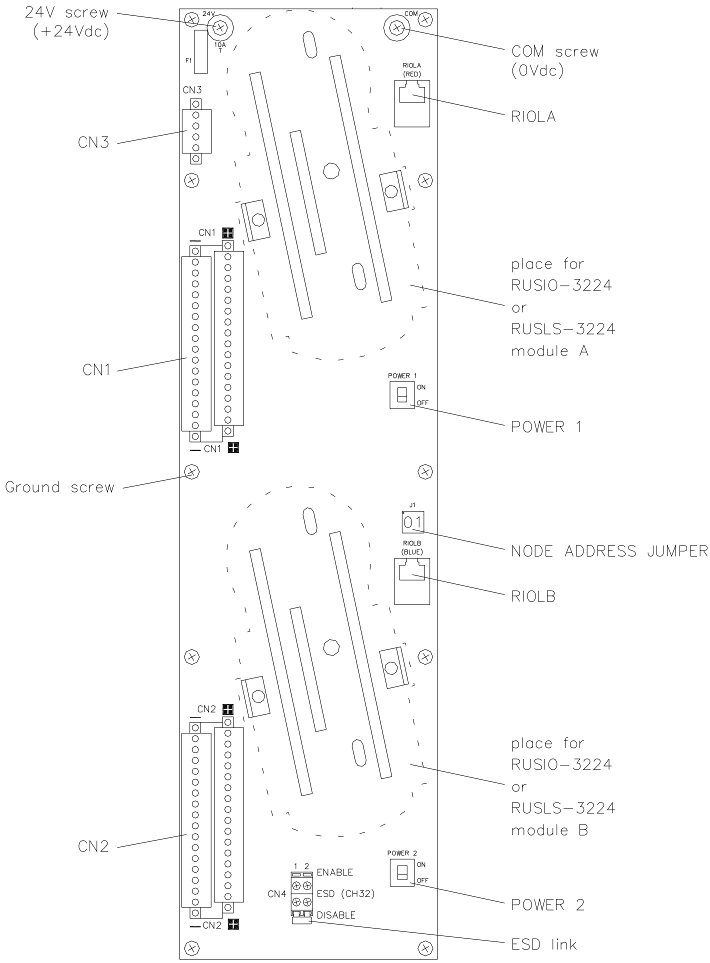
IOTA-R24

Redundant IO Termination Assembly

Description

The IOTA-R24 assembly enables the use of a redundant set of RUSIO-3224 or RUSLS-3224 modules. For physical and schematic representations of the IOTA-R24 see Figure 431 on page 690 and Figure 432 on page 692.

Figure 431 Mechanical layout



The IOTA-R24 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

The IOTA-R24 provides for:

- connectors for two (redundant) RUSIO-3224 or RUSLS-3224 modules
- 32 (universal) IO channel connections (**CN1** and **CN2**)
- 4 (identical) V+ connections (**CN3**), for active AI devices
- two RJ45 connectors for 100MB Ethernet communication (RIOLA and RIOLB)
- 24V power connection (24V screw and COM screw to the carrier power rails)

The RUSIO-3224 or RUSLS-3224 modules are placed on the indicated positions of the IOTA-R24. See Figure 431 on page 690 for details.

The RUSIO-3224 or RUSLS-3224 module in the top position is addressed as module 'A', the bottom one as module 'B'.

The IOTA-R24 module has two switches:

- use **POWER 1** to switch Module 'A' on and off
- use **POWER 2** to switch Module 'B' on and off

The node number of the IOTA-R24 is set by placing the proper node addres jumper on the IOTA-R24 assembly.

The Emergency ShutDown (ESD) function can be enabled or disabled with the **ESD (CH32)** link.

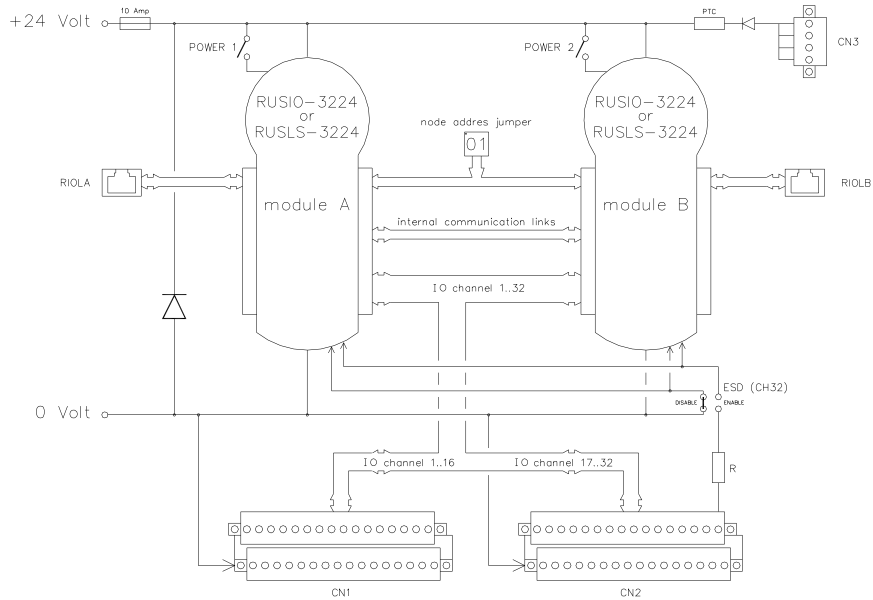
The IO field signals are connected on **CN1** and **CN2**; see Figure 431 on page 690.
The minus-row of **CN1** and **CN2** (left side) are all connected with 0V.
The plus-row of **CN1** and **CN2** (right side) are the 'real' channels.
Any type of IO field signal has only to be connected to the two connections of the applicable universal channel.

CN3 is used to connect active AI devices.

The IOTA-R24 module has two connectors to link the RUSIO-3224 or RUSLS-3224 modules with the SM Controller:

- the **RIOLA** connector is used for module ‘A’
- the **RIOLB** connector is used for module ‘B’

Figure 432 Block diagram



Mounting

The IOTA-R24 is mounted on a (metal) carrier (18 inch or 36 inch long). For details see:

- “MCAR-01” on page 75.
- “MCAR-02” on page 80.

The carrier provides the ground rail and the (+24V and 0V) power rails.

Connections

Channel 1 thru 16 on CN1

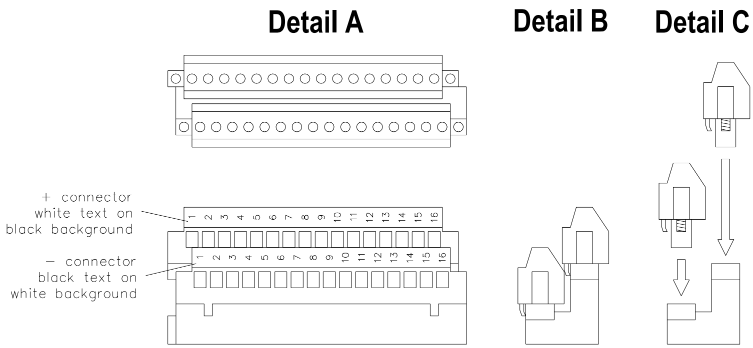
IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 433 Channel 1 thru 16 on CN1



Channel 17 thru 32 on CN2

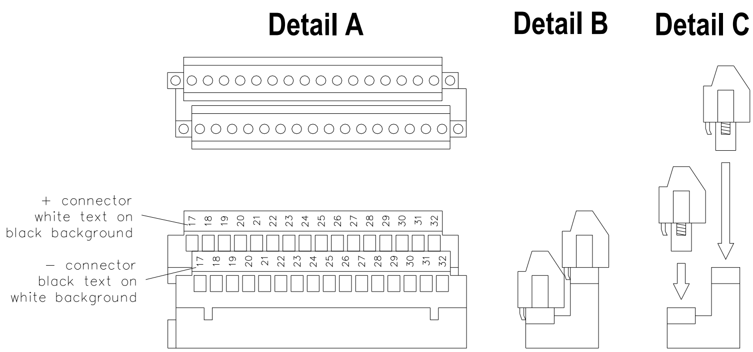
IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 434 Channel 17 thru 32 on CN2



V+ connections on CN3

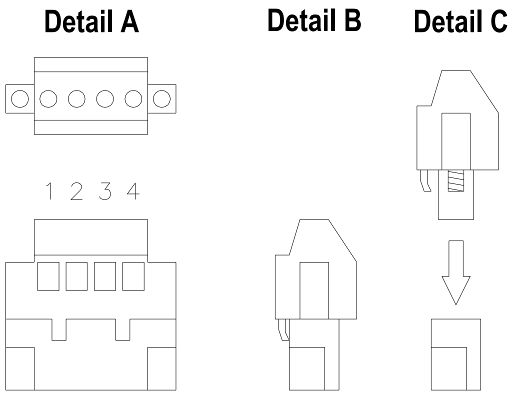
CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

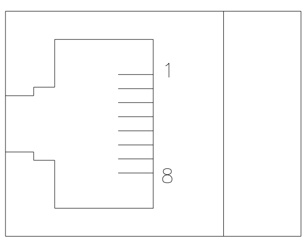
Figure 435 V+ connections on CN3



Ethernet connectors

The ethernet connectors (**RIOLA** ans **RIOLB**) are shielded RJ-45 connectors.

The pin assignment of the RJ-45 connectors is shown below.



Contact	Signal	Direction	Description
1	TD+	Out	Transmitted data
2	TD-	Out	Transmitted data
3	RD+	In	Received data
4	-		
5	-		
6	RD-	In	Received data
7	-		
8	-		
Case	Shield		HF-connection to earth

ESD enable / disable link

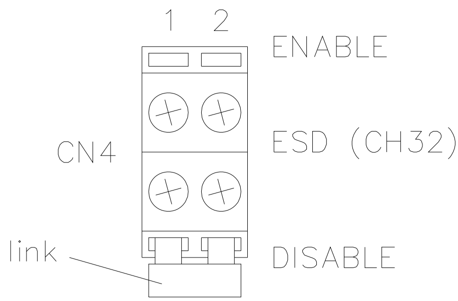
The ESD function (on channel 32) can be enabled (or disabled) with a link on the IOTA.

In case the link is placed in the drawn position (See Figure 436 on page 695), channel 32 can be used as universal channel (analog or digital; input or output).

In case the link is in the ENABLE position, channel 32 must be used as ESD input.

A (normally closed) ESD switch (with 1 kOhm series resistor) must be connected between CH32+ and CH32- of the IOTA.

Figure 436 ESD (CH32) link



Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.
The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.
For an example of a node address jumper see Figure 437 on page 696.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

Figure 437 Node address jumper - front and side view

RUSIO / RUSLS connections

The IOTA-R24 assembly supports all IO types that can be configured in the RUSIO-3224 or RUSLS-3224 module.

The supported IO types are:

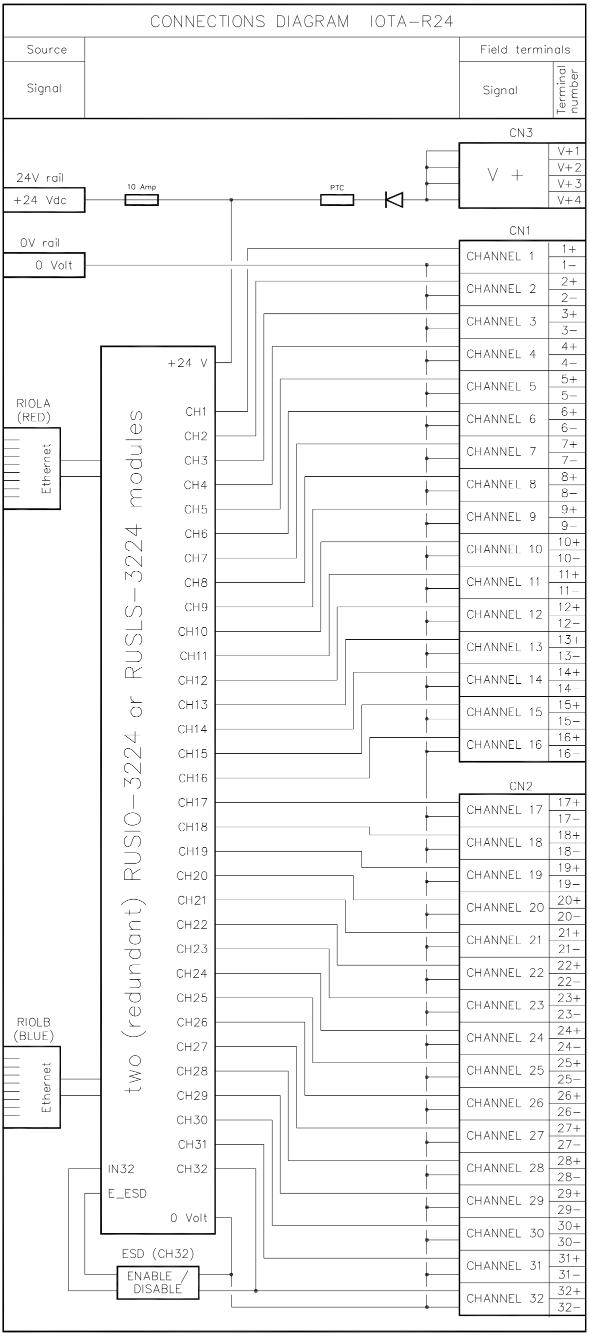
- Line monitored digital input
- Non line monitored digital input
- Line monitored ESD input (on Channel 32)
- Analog input 0-20mA or 4-20mA
- Digital output (0.5 Amp), with or without configurable line monitoring
- Multiple digital output (1 Amp or 2 Amp), with or without line monitoring
- Analog output 0-20mA or 4-20mA

Further details on the connection and specifications of these IO types is described elsewhere. See “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Figure 438 on page 698 shows the IO connection diagram of the IOTA-R24 .

The two RUSIO-3224 or RUSLS-3224 modules are connected in parallel. Each one is capable of controlling the IO.

Figure 438 Connection diagram



Technical data

The IOTA-R24 assembly has the following specifications:

General	Type number:	FC-IOTA-R24
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV pending
Power	Supply voltage:	24 Vdc -15%..+30%
	Supply load:	max. 10 A
	Reverse polarity protection:	parallel diode (blows the fuse)
	Fuse:	
	• rating:	10 Amp, 58V
	• type:	TAC ATO Style Blade Fuse
	• manufacturer:	Littelfuse
	• ordernumber:	142.6185.510_
	V+ pins:	
	• max. current:	1 Amp (total of four CN3 pins)
	• max. voltage drop:	<1.5V (at 0.7A)
	• max. reverse voltage:	36V
Connections	24V supply:	2 x M4 (to power rail of the carrier)
	Ground:	10 x M3.5 (to metal of the carrier)
	Ethernet:	RJ-45
	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
	Screw terminals (CN1,CN2,CN3):	
	• max. wire diameter:	0.50 .. 2.50 mm2
	• strip length:	7 mm
Physical Data	Dimensions (H x W x D):	64 x 120.7 x 443.2 mm 2.52 x 4.75 x 17.45 in
	Weight:	0.57 kg 1.26 lbs

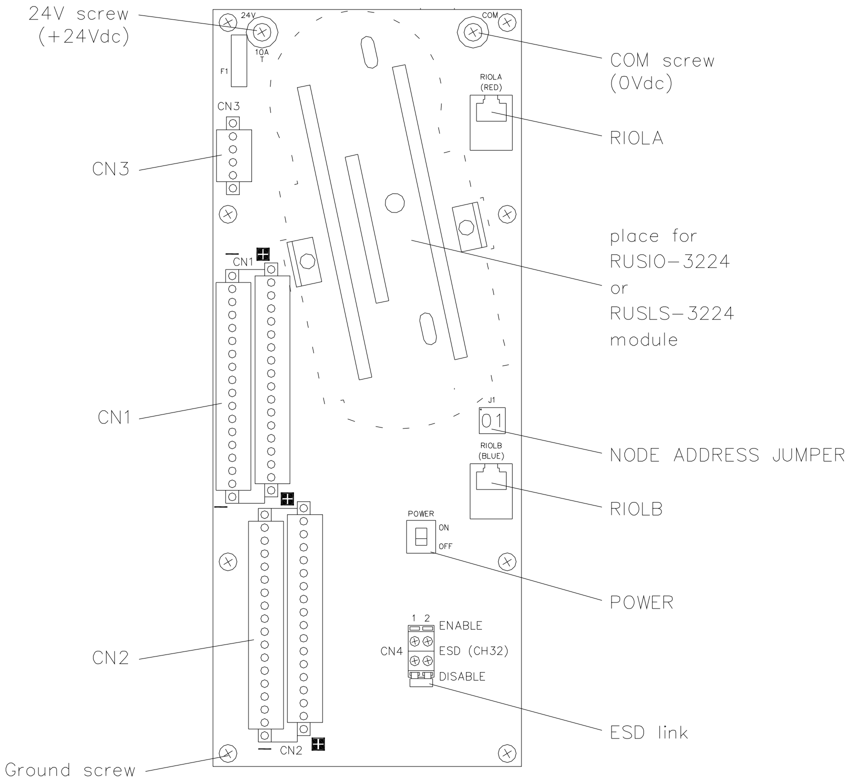
IOTA-NR24

Non-redundant IO Termination Assembly

Description

The IOTA-NR24 assembly enables the use of one RUSIO-3224 or RUSLS-3224 module. For physical and schematic representations of the IOTA-NR24 see Figure 439 on page 700 and Figure 440 on page 702.

Figure 439 Mechanical layout



The IOTA-NR24 can be used in applications up to SIL 3, in compliance with IEC 61508/61511.

The IOTA-NR24 provides for:

- connectors for one RUSIO-3224 or RUSLS-3224 module
- 32 (universal) IO channel connections (**CN1** and **CN2**)
- 4 (identical) V+ connections (**CN3**), for active AI devices
- two RJ45 connectors for 100MB Ethernet communication (RIOLA and RIOLB)
- 24V power connection (24V screw and COM screw to the carrier power rails)

The RUSIO-3224 or RUSLS-3224 module is placed on the indicated position of the IOTA-NR24. See Figure 439 on page 700 for details.

The IOTA-NR24 module has a switch:

- use **POWER** to switch the Module on and off

The node number of the IOTA-NR24 is set by placing the proper node addres jumper on the IOTA-NR24 assembly.

The Emergency ShutDown (ESD) function can be enabled or disabled with the **ESD (CH32)** link.

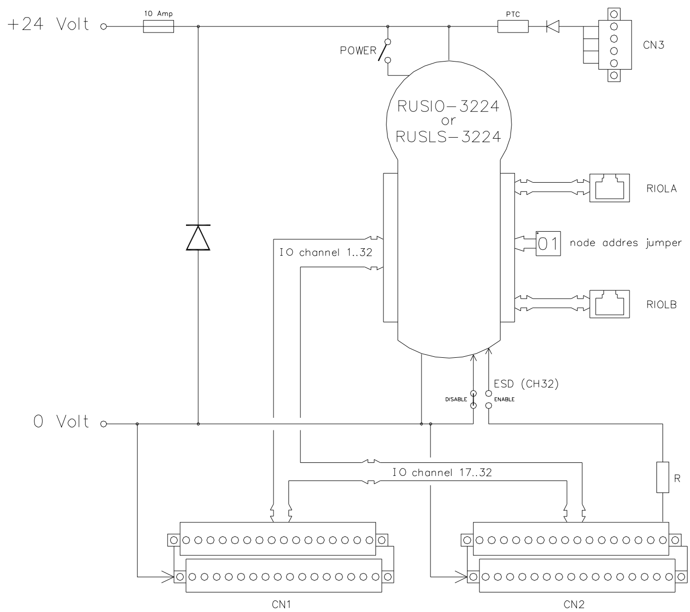
The IO field signals are connected on **CN1** and **CN2**; see Figure 439 on page 700.
The minus-row of **CN1** and **CN2** (left side) are all connected with 0V.
The plus-row of **CN1** and **CN2** (right side) are the 'real' channels.
Any type of IO field signal has only to be connected to the two connections of the applicable universal channel.

CN3 is used to connect active AI devices.

The IOTA-NR24 module has two connectors to link the RUSIO-3224 or RUSLS-3224 module with the SM Controller:

- the **RIOLA** connector is used for link ‘A’
- the **RIOLB** connector is used for link ‘B’

Figure 440 Block diagram



Mounting

The IOTA-NR24 is mounted on a (metal) carrier (18 inch or 36 inch long). For details see:

- “MCAR-01” on page 75.
- “MCAR-02” on page 80.

The carrier provides the ground rail and the (+24V and 0V) power rails.

Connections

Channel 1 thru 16 on CN1

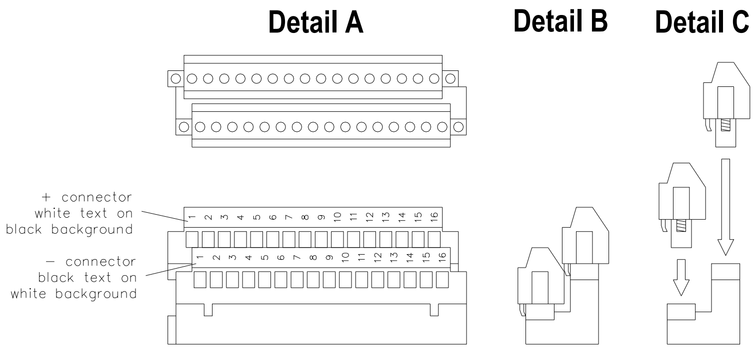
IO-channel 1 thru 16 are terminated on CN1.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 441 Channel 1 thru 16 on CN1



Channel 17 thru 32 on CN2

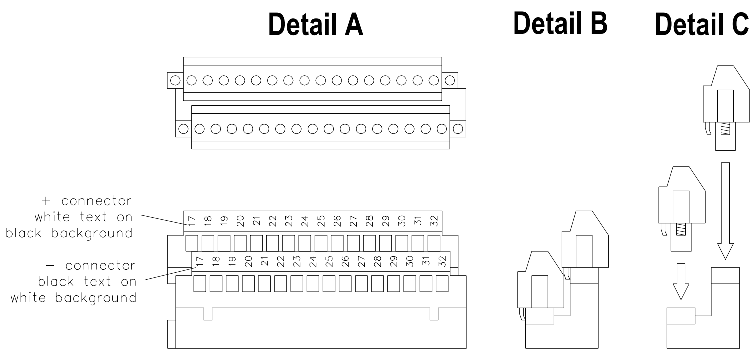
IO-channel 17 thru 32 are terminated on CN2.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connectors placed.

Detail C shows the second side-view with the field-connectors removed.

Figure 442 Channel 17 thru 32 on CN2



V+ connections on CN3

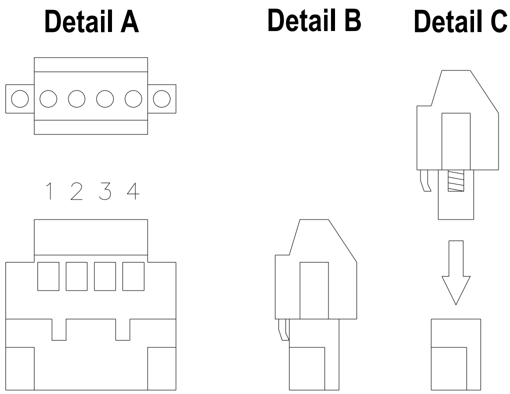
CN3 has four (uni-directional) V+ connections for field signals that require a passive analog input. For details about this type of channel configuration see “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Detail A shows the top and side view (field-connectors placed).

Detail B shows the second side-view with the field-connector placed.

Detail C shows the second side-view with the field-connector removed.

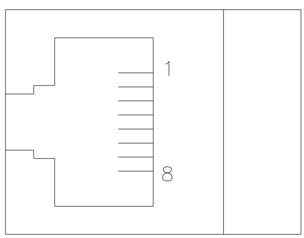
Figure 443 V+ connections on CN3



Ethernet connectors

The ethernet connectors (**RIOLA** ans **RIOLB**) are shielded RJ-45 connectors.

The pin assignment of the RJ-45 connectors is shown below.



Contact	Signal	Direction	Description
1	TD+	Out	Transmitted data
2	TD-	Out	Transmitted data
3	RD+	In	Received data
4	-		
5	-		
6	RD-	In	Received data
7	-		
8	-		
Case	Shield		HF-connection to earth

ESD enable / disable link

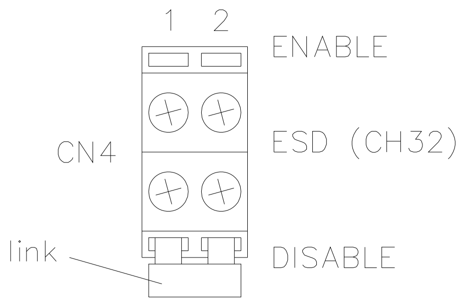
The ESD function (on channel 32) can be enabled (or disabled) with a link on the IOTA.

In case the link is placed in the drawn position (See Figure 444 on page 705), channel 32 can be used as universal channel (analog or digital; input or output).

In case the link is in the ENABLE position, channel 32 must be used as ESD input.

A (normally closed) ESD switch (with 1 kOhm series resistor) must be connected between CH32+ and CH32- of the IOTA.

Figure 444 ESD (CH32) link



Node address jumpers

The node address jumper is used to give the processors in the RUSIO-3224 or RUSLS-3224 module(s) the node address of the IOTA.
The jumper is a 10.2 x 10.2 x 6.1 mm (0.4 x 0.4 x 0.24 in) gray plastic jumper set; it has a (two digit) number that is clearly visible.
For an example of a node address jumper see Figure 445 on page 706.

The jumpers are available in kits of ten numbers:

- 51153818-201 is a kit with the numbers 01 thru 10.
- 51153818-202 is a kit with the numbers 11 thru 20.
- 51153818-203 is a kit with the numbers 21 thru 30.
- 51153818-204 is a kit with the numbers 31 thru 40.

Figure 445 Node address jumper - front and side view

RUSIO / RUSLS connections

The IOTA-NR24 assembly supports all IO types that can be configured in the RUSIO-3224 or RUSLS-3224 module.

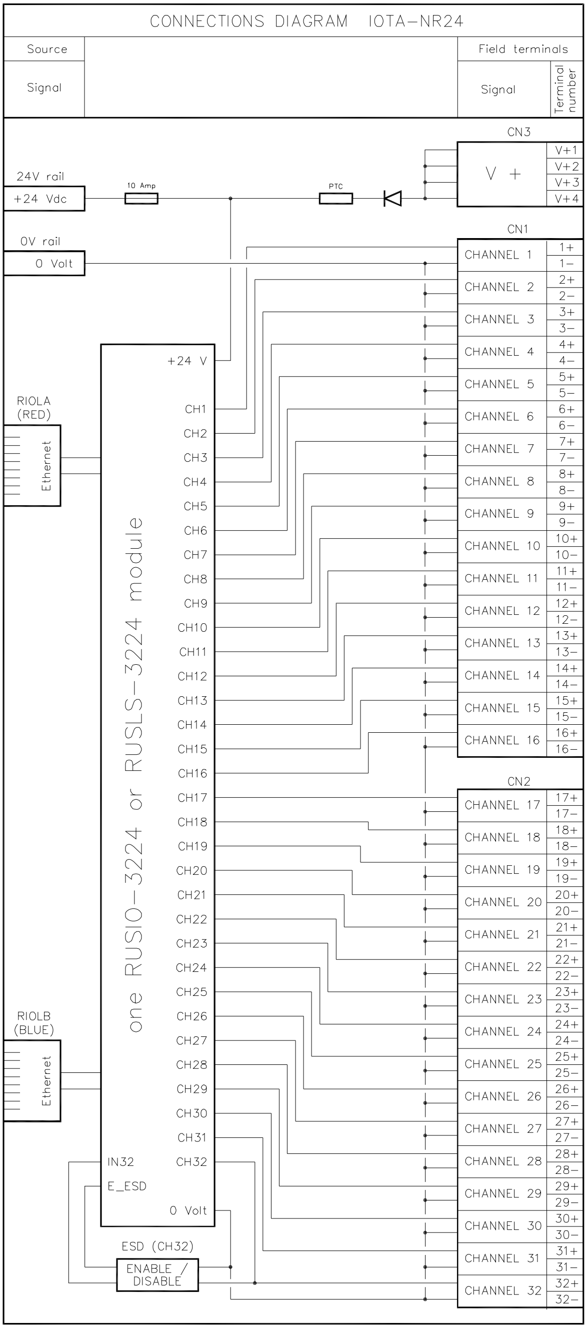
The supported IO types are:

- Line monitored digital input
- Non line monitored digital input
- Line monitored ESD input (on Channel 32)
- Analog input 0-20mA or 4-20mA
- Digital output (0.5 Amp), with or without configurable line monitoring
- Multiple digital output (1 Amp or 2 Amp), with or without line monitoring
- Analog output 0-20mA or 4-20mA

Further details on the connection and specifications of these IO types is described elsewhere. See “RUSIO-3224” on page 416 or “RUSLS-3224” on page 439.

Figure 446 on page 708 shows the IO connection diagram of the IOTA-NR24 .

Figure 446 Connection diagram



Technical data

The IOTA-NR24 assembly has the following specifications:

General	Type number:	FC-IOTA-NR24
	Operating temperature:	-40 .. +70 degC (-40 .. +158 degF)
	Storage temperature:	-40 .. +85 degC (-40 .. +185 degF)
	Relative humidity:	10..95% (non condensing)
	Pollution:	Pollution degree 2 or better
	Approvals:	CE; UL, TUV pending
Power	Supply voltage:	24 Vdc -15%..+30%
	Supply load:	max. 10 A
	Reverse polarity protection:	parallel diode (blows the fuse)
	Fuse:	
	• rating:	10 Amp, 58V
	• type:	TAC ATO Style Blade Fuse
	• manufacturer:	Littelfuse
	• ordernumber:	142.6185.510_
	V+ pins:	
	• max. current:	1 Amp (total of four CN3 pins)
	• max. voltage drop:	<1.5V (at 0.7A)
	• max. reverse voltage:	36V
Connections	24V supply:	2 x M4 (to power rail of the carrier)
	Ground:	8 x M3.5 (to metal of the carrier)
	Ethernet:	RJ-45
	IO (CN1 and CN2):	Weidmuller: BLZ 5.08/16/90F SN SW
	V+ (CN3):	Weidmuller: BLZ 5.08/4/90F SN SW
	Screw terminals (CN1,CN2,CN3):	
	• max. wire diameter:	0.50 .. 2.50 mm2
	• strip length:	7 mm
Physical Data	Dimensions (H x W x D):	64 x 120.7 x 293.4 mm 2.52 x 4.75 x 11.55 in
	Weight:	0.46 kg 1.01 lbs

System interconnection cables

16

This chapter describes the following items:

General info about System Interconnection Cables (SIC)

System Interconnection Cables (SIC) are divided in these main groups:

- SIC to connect SM chassis IO to FTAs.
  See “SIC for SM chassis IO” on page 712.
- SIC to connect CP backplane to external contact.
  See “SIC for CP backplane” on page 714.
- SIC to connect SM universal IO to FTAs.
  See “SIC for SM universal IO” on page 714.

SIC for SM chassis IO

This type of System Interconnection Cable (SIC) transports field signals to SM chassis IO modules. Depending on whether or not an FTA is used in the configuration, you either use a SICC cable, or a SICP cable. Refer to Table 79 on page 712 for input signals and Table 80 on page 712 for output signals.

Table 79 possible ways to connect input field signals to input modules
(read table from left to right to see possible interface/wiring options)

Input Signals				
Field signal		SICP cable		Input module
Field signal		SICP cable	Input converter module	Input module
Field signal	FTA	SICC cable		Input module
Field signal	FTA	SICC cable	Input converter module	Input module

Table 80 possible ways to connect output field signals to output modules
(read table from left to right to see possible interface/wiring options)

Output Signals				
Output module		SICP cable		Field signal
Output module	Output converter module	SICP cable		Field signal
Output module		SICC cable	FTA	Field signal
Output module	Output converter module	SICC cable	FTA	Field signal

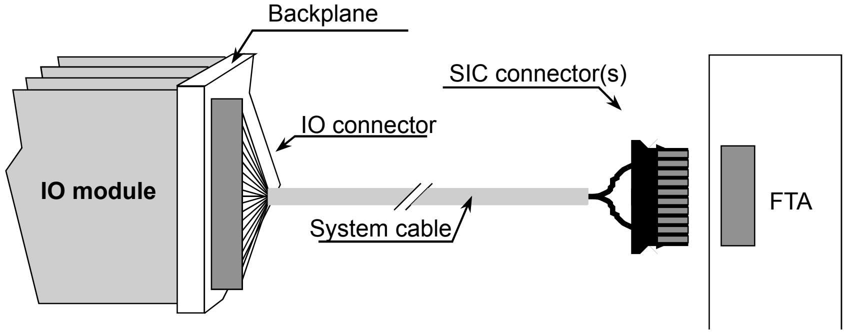
At the back plane side each of the above mentioned connection methods uses an IO-connector.

At the field signal side:

- SICC cables connect to an FTA with a special (20-pins) FTA-connector; the connection principle for this method is shown in Figure 447 on page 713,
- SICP cables connect directly to field signals with 20 wires (crimp pins); the connection principle for this method is shown in Figure 448 on page 713.

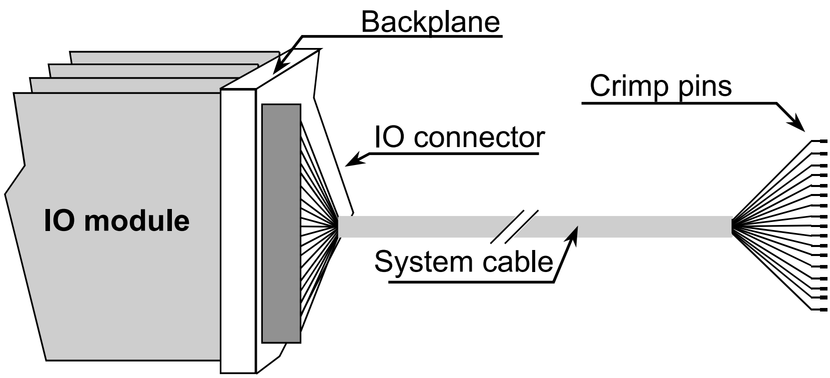
Connection principles

Figure 447 Principle of SICC connection method



The wiring method that uses SIC cables terminating on crimp pins (SICP) is shown in Figure 448 on page 713.

Figure 448 Principle of SICP connection method



Related topic(s): "SICC-0001/Lx" on page 715
"SICP-0001/Lx" on page 718

SIC for CP backplane

This type of System Interconnection Cable (SIC) is used to connect one or more inputs on the CP backplane with external (potential free) contacts.

Related topic(s): "SICP-0002/L3" on page 722

SIC for SM universal IO

This type of System Interconnection Cable (SIC) transports field signals to SM universersal IO modules.

Related topic(s): "SICC-1002/Lx" on page 725
"SICC-2001/Lx" on page 728
"CA-HWC300-AIO-DIO-xM" on page 731

SICC-0001/Lx

System Interconnection Cable for chassis IO terminating on FTAs (SICC)

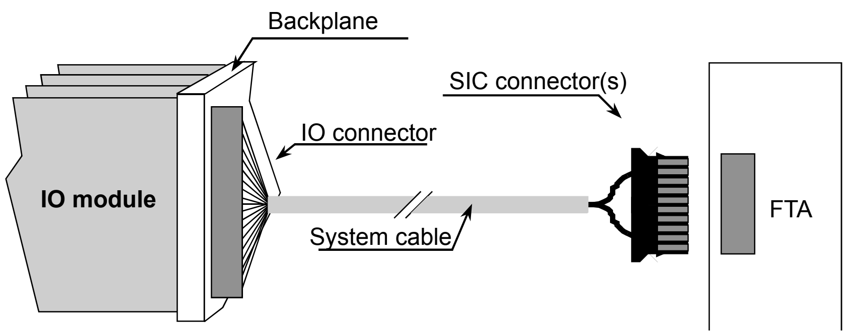
Description

System interconnection cables - for SM chassis IO - with termination to Field Termination Assemblies (FTA) can connect Safety Manager IO modules to FTAs (via an IO backplane). Figure 449 on page 715 illustrates this process. These cables are called SICC cables and have one IO connector on one end and one 20-pin FTA connector on the other end.

Connection principles

The wiring method for SIC cables terminating on FTAs (SICC) is shown in Figure 449 on page 715.

Figure 449 Principle of SICC connection method



Technical data

System interconnection cables terminating on FTAs have the following specifications:

General	Type number:	FS-SICC-0001/Lx (where × = length)
	Cable type:	20 × AWG 22 (= 0.34 mm²) double shielded
	Outer diameter (nominal):	9.93 mm / 0.39 in
	Available lengths:	× = 3.25 m, 5 m, 6 m, 8 m, 10 m, 15 m, 20 m, 25 m and 30 m.

SICC Cable connections

This tables gives an overview of all possible connections of FTAs to input and output modules.

Table 81 Connections for standard SICC-0001/Lx cable to input modules

Signal				**Connector pin**	
SDI-1624 **SDI-1648**	**SAI-0410**	**SAI-1620m**	**SDIL-1608**	**IO module**	**FTA**
		Shield		41	–
0 Vdc	IN1-	0 Volt	0 Volt	40	A10
0 Vdc	IN1+	0 Volt	0 Volt	37	B10
IN1		IN1	IN1	36	A9
IN2		IN2	IN2	33	B9
IN3		IN3	IN3	32	A8
IN4		IN4	IN4	29	B8
IN5		IN5	IN5	28	A7
IN6		IN6	IN6	25	B7
IN7	IN2+	IN7	IN7	24	A6
IN8	IN2-	IN8	IN8	21	B6
IN9	IN3-	IN9	IN9	20	A5
IN10	IN3+	IN10	IN10	17	B5
IN11		IN11	IN11	16	A4
IN12		IN12	IN12	13	B4
IN13		IN13	IN13	12	A3
IN14		IN14	IN14	9	B3
IN15		IN15	IN15	8	A2
IN16		IN16	IN16	5	B2
+ Vext	IN4+	0 Volt	+ Vext (8 Vdc)	4	A1
+ Vext	IN4-	+ Vext/8	Earth	1	B1

Table 82 Connections for standard SICC-0001/Lx cable to output modules

Signal								**Connector pin**	
SDO-0824	**SAO-0220m**	**DO-1224**	**RO-1024**	**DO-1624**	**SDO-04110 SDO-0448**	**SDO-0424**	**SDOL-0424**	**IO module**	**FTA**
–	Shield	–	–	–	–	–	–	41	–
(0 Vdc)	–	–	OUT1 c	–	–	–	–	40	A10
(0 Vdc)	–	–	OUT1 no	–	–	–	–	37	B10
OUT1+	–	OUT1	OUT2 c	OUT1	(0 Vdc)	OUT1+	(0 Vdc)	36	A9
OUT1–	–	OUT2	OUT2 no	OUT2	(0 Vdc)	OUT1–	(0 Vdc)	33	B9
OUT2+	0V (1)	OUT3	OUT3 c	OUT3	OUT1+	OUT1+	OUT1+	32	A8
OUT 2–	–	OUT4	OUT3 no	OUT4	OUT1–	OUT1–	OUT1-	29	B8
OUT3+	mA1	OUT5	OUT4 c	OUT5	0 Vdc	OUT2+	(0 Vdc)	28	A7
OUT3–	Loop1	OUT6	OUT4 no	OUT6	(0 Vdc)	OUT2–	(0 Vdc)	25	B7
OUT4+	–	OUT7	OUT5 c	OUT7	OUT2+	OUT2+	OUT2+	24	A6
OUT4–	–	OUT8	OUT5 no	OUT8	OUT2–	OUT2–	OUT2-	21	B6
OUT5+	0V (2)	OUT9	OUT6 c	OUT9	(0 Vdc)	OUT3+	(0 Vdc)	20	A5
OUT5–	–	OUT10	OUT6 no	OUT10	(0 Vdc)	OUT3–	(0 Vdc)	17	B5
OUT6+	mA2	OUT11	OUT7 c	OUT11	OUT3+	OUT3+	OUT3+	16	A4
OUT6–	Loop2	OUT12	OUT7 no	OUT12	OUT3–	OUT3–	OUT3-	13	B4
OUT7+	–	0 Vdc	OUT8 c	OUT13	(0 Vdc)	OUT4+	(0 Vdc)	12	A3
OUT7–	–	0 Vdc	OUT8 no	OUT14	(0 Vdc)	OUT4–	(0 Vdc)	9	B3
OUT8+	–	0 Vdc	OUT9 c	OUT15	OUT4+	OUT4+	OUT4+	8	A2
OUT8–	–	0 Vdc	OUT9 no	OUT16	OUT4–	OUT4–	OUT4-	5	B2
(0 Vdc)	–	0 Vdc	OUT10 c	0 Vdc	(0 Vdc)	(0 Vdc)	(0 Vdc)	4	A1
(0 Vdc)	–	0 Vdc	OUT10 no	0 Vdc	(0 Vdc)	(0 Vdc)	(0 Vdc)	1	B1

SICP-0001/Lx

System Interconnection Cable for chassis IO terminating on crimp pins (SICP)

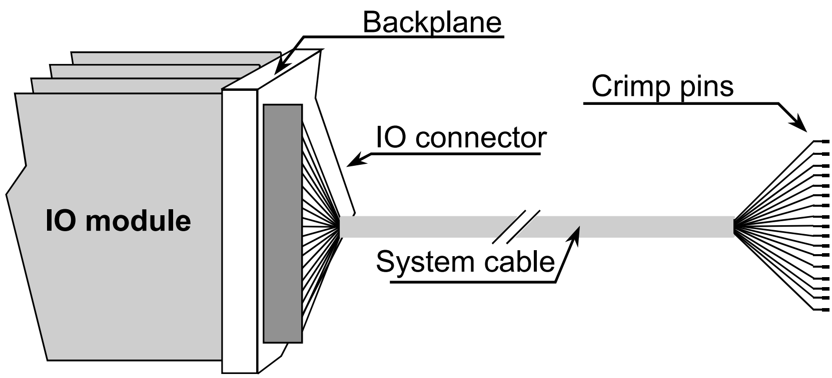
Description

System interconnection cables - for SM chassis IO - terminating on crimp pins are suitable for the connection to screw terminals (see Figure 450 on page 718). These cables are called SICP cables and are fitted with one IO connector on one end and crimp pins on the other.

Connection principle

The wiring method that uses SIC cables terminating on crimp pins (SICP) is shown in Figure 450 on page 718.

Figure 450 Principle of SICP connection method



Technical data

The SICP cable has the following specifications:

General	Type number:	FS-SICP-0001/Lx (where x = length)
	Cable type:	20 × AWG 22 (= 0.34 mm²) double shielded
	Outer diameter (nominal):	9.93 mm / 0.39 in
	Available lengths:	x = 3.25 m, 5 m, 6 m, 8 m, 10 m, 15 m, 20 m, 25 m and 30 m.

SICP Cable connections

The tables below describe possible connections of SIC cables to input and output modules.

Table 83 connections for standard SICP-0001/Lx cable to input modules

Signal				Pins	
SDI-1624 **SDI-1648**	**SAI-0410**	**SAI-1620m**	**SDIL-1608**	**IO module connector pin**	**Color code crimp pin**
		Shield		41	Yellow / Green
0 Vdc	IN1–	0 Volt	0 Volt	40	White
0 Vdc	IN1+	0 Volt	0 Volt	37	Brown
IN1		IN1	IN1	36	Green
IN2		IN2	IN2	33	Yellow
IN3		IN3	IN3	32	Gray
IN4		IN4	IN4	29	Pink
IN5		IN5	IN5	28	Blue
IN6		IN6	IN6	25	Red
IN7	IN2+	IN7	IN7	24	Black
IN8	IN2–	IN8	IN8	21	Violet
IN9	IN3–	IN9	IN9	20	Gray / Pink
IN10	IN3+	IN10	IN10	17	Red / Blue
IN11		IN11	IN11	16	White / Green
IN12		IN12	IN12	13	Brown / Green
IN13		IN13	IN13	12	White / Yellow
IN14		IN14	IN14	9	Yellow / Brown
IN15		IN15	IN15	8	White / Gray
IN16		IN16	IN16	5	Gray / Brown
+ Vext	IN4+	0 Volt	+Vext (8 Vdc)	4	White / Pink
+ Vext	IN4–	+ Vext/8	Earth	1	Pink / Brown

Table 84 connections for standard SICP-0001/Lx cable to output modules

Signal								Pins	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110 SDO-0448	SDO-0424	SDOL-0424	IO module connector pin	Color code crimp pin
					Shield		Shield	41	Yellow / Green
			OUT1 c					40	White
			OUT1 no					37	Brown
OUT1+		OUT1	OUT2 c	OUT1		OUT1+		36	Green
OUT1-		OUT2	OUT2 no	OUT2		OUT1-		33	Yellow
OUT2+	0V (1)	OUT3	OUT3 c	OUT3	OUT1+	OUT1+	OUT1+	32	Gray
OUT2–		OUT4	OUT3 no	OUT4	OUT1–	OUT1–	OUT1–	29	Pink
OUT3+	mA1	OUT5	OUT4 c	OUT5		OUT2+		28	Blue
OUT3-	Loop 1	OUT6	OUT4 no	OUT6		OUT2-		25	Red
OUT4+		OUT7	OUT5 c	OUT7	OUT2+	OUT2+	OUT2+	24	Black
OUT4–		OUT8	OUT5 no	OUT8	OUT2–	OUT2-	OUT2–	21	Violet
OUT5+	0V (2)	OUT9	OUT6 c	OUT9		OUT3+		20	Gray / Pink
OUT5-		OUT10	OUT6 no	OUT10		OUT3–		17	Red / Blue
OUT6+	mA2	OUT11	OUT7 c	OUT11	OUT3+	OUT3+	OUT3+	16	White / Green
OUT6–	Loop 2	OUT12	OUT7 no	OUT12	OUT3–	OUT3–	OUT3–	13	Brown / Green
OUT7+		0 Vdc	OUT8 c	OUT13		OUT4+		12	White / Yellow
OUT7-		0 Vdc	OUT8 no	OUT14		OUT4–		9	Yellow / Brown
OUT8+		0 Vdc	OUT9 c	OUT15	OUT4+	OUT4+	OUT4+	8	White / Gray
OUT8–		0 Vdc	OUT9 no	OUT16	OUT4–	OUT4–	OUT4–	5	Gray / Brown
		0 Vdc	OUT10 c	0 Vdc				4	White / Pink

Table 84 connections for standard SICP-0001/Lx cable to output modules *(continued)*

Signal									Pins	
SDO-0824	SAO-0220m	DO-1224	RO-1024	DO-1624	SDO-04110	SDO-0448	SDO-0424	SDOL-0424	IO module connector pin	Color code crimp pin
		0 Vdc	OUT10 no	0 Vdc					1	Pink / Brown

c = common

no = normally open

SICP-0002/L3

Digital input cable for Control Processor backplane

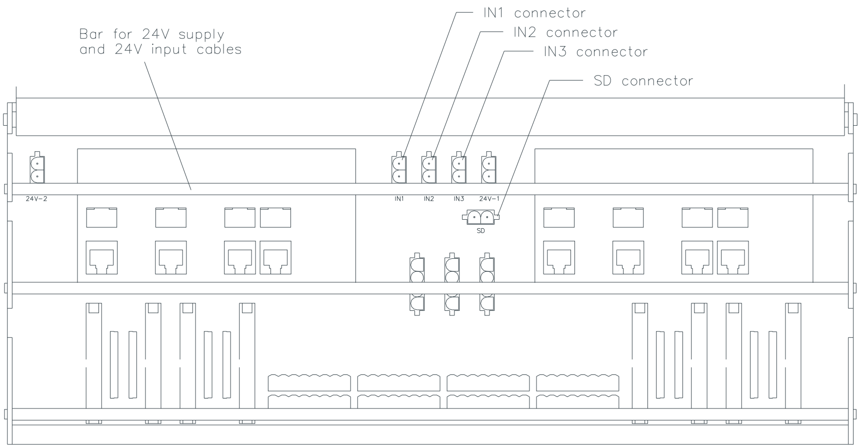
Description

The SICP-0002/L3 digital input cable for the Control Processor backplane is used to connect the SD and INx input(s) on the CP backplane with external (potential free) contacts.

Safety Manager

The cables can be placed on the connectors SD, IN1, IN2 resp. IN3, as indicated in Figure 451 on page 722.

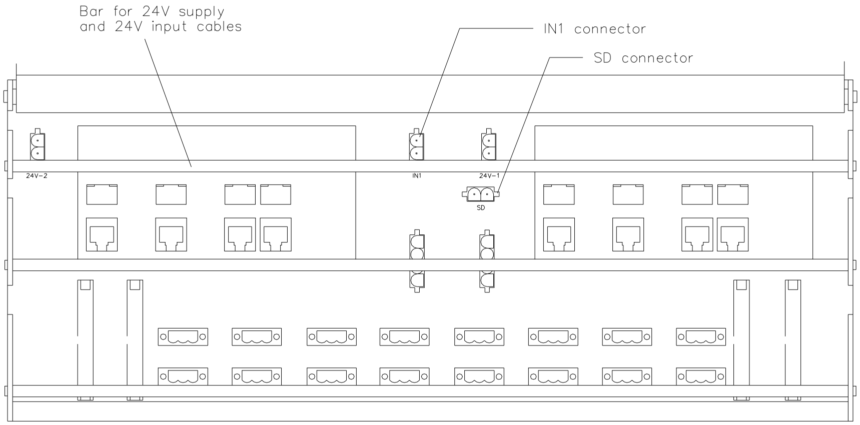
Figure 451 Safety Manager - Position of the SD, IN1, IN2 and IN3 connectors on the CP-backplane.



Safety Manager A.R.T.

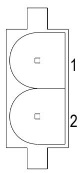
The cables can be placed on the connectors SD and IN1 as indicated in Figure 452 on page 723.

Figure 452 Safety Manager A.R.T. - Position of the SD and IN1 connectors on the CP-backplane.

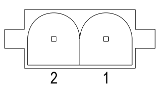


Pin allocation

The back view and pin allocation of the IN1, IN2 and IN3 connectors are:

		IN1	IN2	IN3
	1	+24V_red	+24V_red	+24V_red
	2	input1	input2	input3

The back view and pin allocation of the SD connector is:

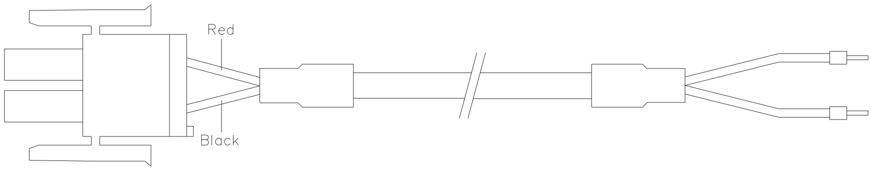
		SD
	1	+24V_sd
	2	input

Layout

Figure 453 on page 724 shows the layout of the FS-SICP-0002/L3 input cable.

The red wire connects to +24V. The black wire connects to the input.

Figure 453 Layout of the FS-SICP-0002/L3 input cable



Technical data

General	Type number:	FS-SICP-0002/L3
	Approvals:	CE, UL, CSA, FM
Cable	Type:	Alphawire 1899AWG/2C (2 × 1.3 mm^2)
	Length:	3 m
Connectors	CP side:	2 pole mate-n-lock
	Field side:	(crimp-on) pin

SICC-1002/Lx

System Interconnection Cable for universal IO terminating on FTAs (SICC)

Description

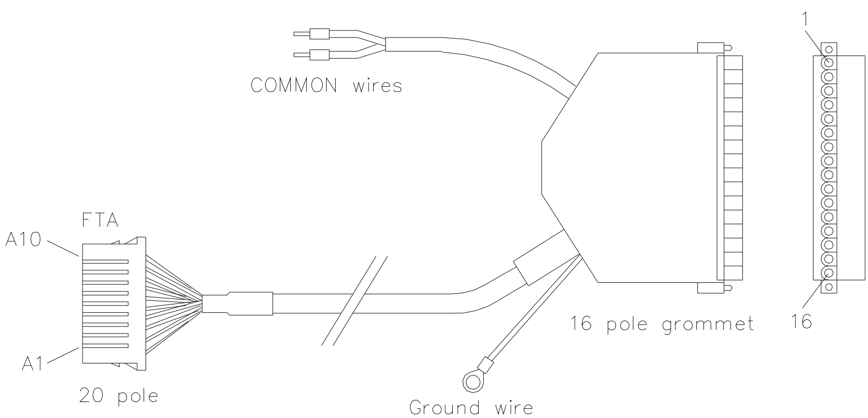
System interconnection cables - for SM universal IO - with termination to Field Termination Assemblies (FTA) connect Safety Manager universal IO modules to FTAs (via an IOTA).

Figure 454 on page 725 shows the SICC-1002/Lx[3].
The 16-pole grommet connects to channel 1 thru 16 (high row of CN1 position) or channel 17 thru 32 (high row of CN2 position) of the IOTA.
The two COMMON wires are connected to:

- CN3 of the IOTA (pins 1 and 2 for channel 1 thru 16 or pins 3 and 4 for channel 17 thru 32), if the field devices supply the channel energy,
- two pins of the low row connector of CN1 for channel 1 thru 16 or to the low-row of connector 2 for channel 17 thru 32, if the IOTA needs to supply the channel energy.

The 20-pole connector is placed on the FTA.
The grommet has a (8 inch long) wire to ground the cable shield.

Figure 454 SICC-1002/Lx - Mechanical layout

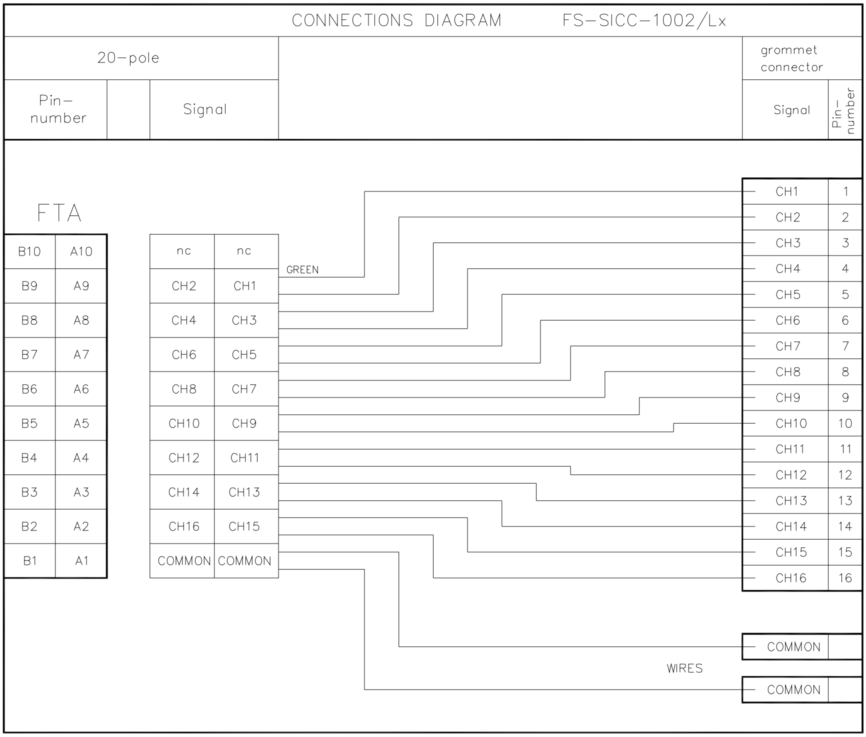


3. The ‘x’ in the model number represents the cable lenght in meters.

Connections

Figure 455 on page 726 shows the connection diagram of the SICC-1002/Lx.

Figure 455 Connection diagram



Technical data

General	Type number:	FS-SICC-1002/Lx [1]
	• available length (m):	3, 5, 6 and 10
	Approvals:	UL; CSA pending
Cable	Type:	20 x AWG22 shielded cable AWG style 2464
	COMMON wires:	AWG20
Connectors	20-pole:	2x10 pins Dynamic Housing no. 178289-8
	• make:	TYCO
	Grommet:	SP-BLZ5.08 16P CLAMSHELL
	• make:	Weidmuller
	COMMON wires:	crimp-on cable tube
	Ground wire	Ring terminal (5 mm hole)

1 Where ‘x’ = length.

SICC-2001/Lx

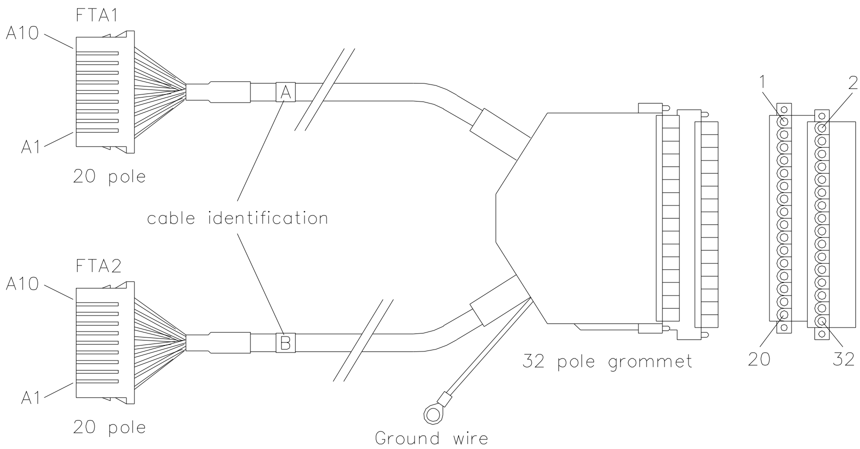
System Interconnection Cable for universal IO terminating on FTAs (SICC)

Description

System interconnection cables - for SM universal IO - with termination to Field Termination Assemblies (FTA) connect Safety Manager universal IO modules to FTAs (via an IOTA).

Figure 456 on page 728 shows the SICC-2001/Lx[4].
The 32-pole grommet connects to channel 1 thru 16 (CN1 position) or channel 17 thru 32 (CN2 position) of the IOTA.
The 20-pole connectors are placed on the FTAs.
The grommet has a (8 inch long) wire to ground the cable shields.

Figure 456 SICC-2001/Lx - Mechanical layout

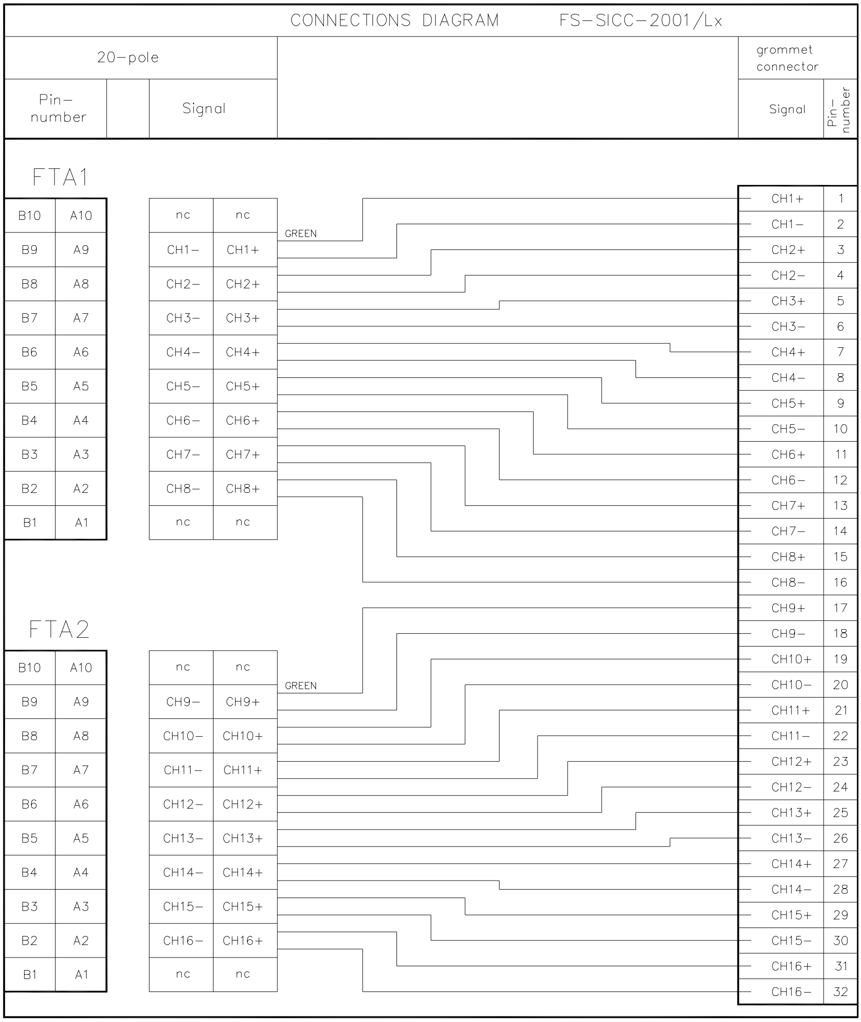


4. The ‘x’ in the model number represents the cable lenght in meters.

Connections

Figure 457 on page 729 shows the connection diagram of the SICC-2001/Lx.

Figure 457 Connection diagram



Technical data

General	Type number:	FS-SICC-2001/Lx [1]
	• available length (m):	3, 5, 6 and 10
	Approvals:	UL; CSA pending
Cable	Type:	20 x AWG22 shielded cable AWG style 2464
Connectors	20-pole:	2x10 pins Dynamic Housing no. 178289-8
	• make:	TYCO
	Grommet:	SP-BLZ5.08 32P CLAMSHELL
	• make:	Weidmuller
	Ground wire	Ring terminal (5 mm hole)

1 Where ‘x’ = length.

CA-HWC300-AIO-DIO-xM

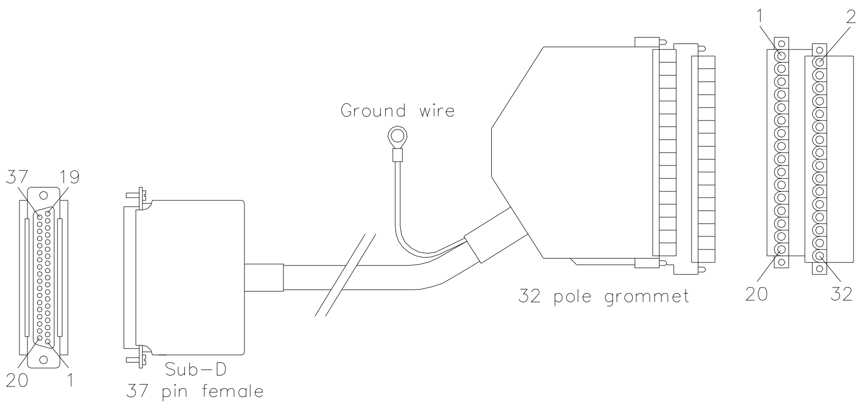
System Interconnection Cable for universal IO terminating on IOTAs (SICC)

Description

System interconnection cables - for SM universal IO - with termination to Field Termination Assemblies (FTA) connect Safety Manager universal IO modules to FTAs (via an IOTA).

Figure 458 on page 731 shows the CA-HWC300-AIO-DIO-xM[5].
The 32-pole grommet connects to channel 1 thru 16 (CN1 position) or channel 17 thru 32 (CN2 position) of the IOTA.
The 37-pin female Sub-D connector is placed on the field termination board.
The grommet has a (8 inch long) wire to ground the cable shield.

Figure 458 CA-HWC300-AIO-DIO-xM - Mechanical layout

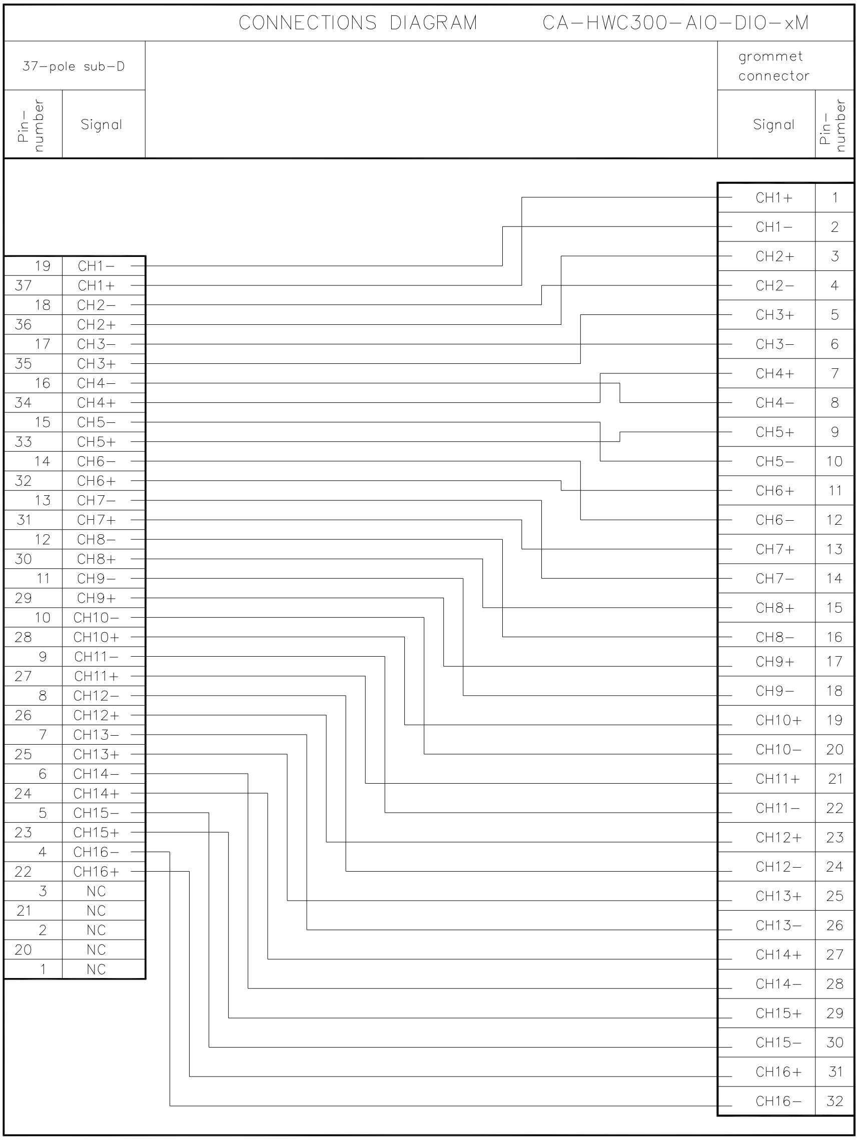


5. The ‘x’ in the model number represents the cable lenght in meters.

Connections

Figure 458 on page 731 shows the connection diagram of the CA-HWC300-AIO-DIO-xM.

Figure 459 Connections diagram



Technical data

System interconnection cables terminating on IOTAs have the following specifications:

General	Type numbers: • available lenghts (m)	CA-HWC300-AIO-DIO-xM (where × = length) 1, 2, 3, 4, 5, 7.5, 10, 12.5, 15, 20, 25, 30
	Approvals:	UL, CSA pending
Cable	Construction type:	22 AWG 7/0096 tinned copper 18 individually twisted pairs overall foil
	Shielding:	aluminium/poly foil 100% coverage 24 AWG 7/32 T.C.DW.
Connectors	Sub-D:	37-pin Sub-D socket female
	Grommet • make	SP-BLZ5.08 32P CLAMSHELL Weidmuller
	Ground wire:	Ring terminal (5 mm hole)

Communication cables

17

This chapter describes the following communication-related items:

General info on communication cables

Safety Manager communication

A Safety Manager communication architecture is created with a specific set of assembly guidelines and materials.

The options are:

- High-speed ethernet (10/100 Mbaud, twisted pair, full duplex) using STP-wiring and RJ45 connectors to an ethernet switch (UCOM-HSE) and offering four RJ45 connector positions as field connection.
- RS485/422 communication (full duplex or half duplex) using a SIC-cable to the FTA (DCOM-232/485) and offering two 9-pole male connectors as field connections.
- RS232 communication (full duplex, no handshake) using a SIC-cable to the FTA (DCOM-232/485) and offering a 9-pole female connector as field connection.

Internal and external cabling

Internal cables connect the Control Processor(s) to the high-speed Ethernet FTA (“UCOM-HSE” on page 28) or to the communication FTA (“DCOM-232/485” on page 675).

External cables connect external devices such as stations, other Safety Managers, network servers, other control systems, and so on to communication FTAs (DCOM-232/485).

Table 85 on page 736 shows all available cables, the items they connect and the type of connection they are used for.

Table 85 Internal and external communication cables

Cable	Connects			Connection type
Internal				
CCI-UNI-01 and CCI-UNI-02	USI-0001 or USI-0002	to	DCOM-232/485	Point-to-point duplex or (RS485) full-duplex
CCI-HSE-01 and CCI-HSE-02	USI-0001 or USI-0002	to	SDW-550 EC MTL 24571	High Speed Ethernet
External				
CCE-232-01/Lx	DCOM-232/485	to	DCOM-232/485	Point-to-point

Table 85 Internal and external communication cables *(continued)*

Cable	Connects			Connection type
CCE-232-02/Lx	Development system	to	DCOM-232/485	Point-to-point
CCE-485-01/Lx	DCOM-232/485	to	DCOM-232/485	Between slaves
CCE-485-02/Lx	PC RS485 BB113	to	DCOM-232/485	Point-to-point duplex or master-slave duplex
CCE-485-04/Lx	PC RS485 BB114	to	DCOM-232/485	Point-to-point duplex or master-slave duplex
CCE-485-05/Lx	PC RS485 QT	to	DCOM-232/485	Point-to-point duplex or master-slave duplex

Internal communication wiring examples

The DCOM-232/485 module (see “DCOM-232/485” on page 675) is connected to the SM Controller chassis.

Figure 460 on page 738 shows the non-redundant connection to either Control Processor 1 or Control Processor 2.

Figure 460 Non-redundant internal communication wiring to a DCOM-232/485 module

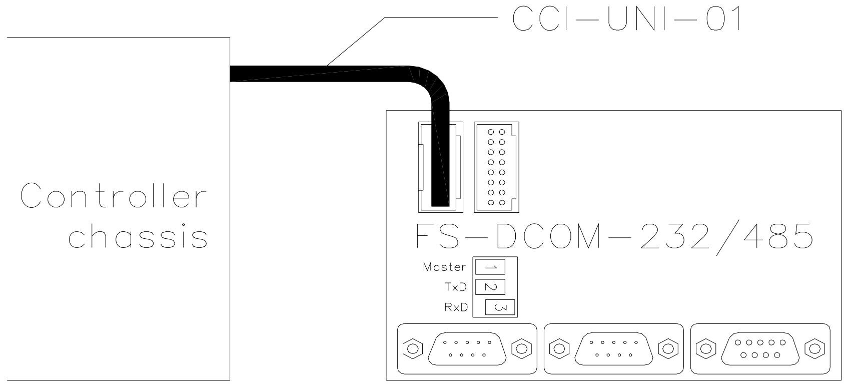
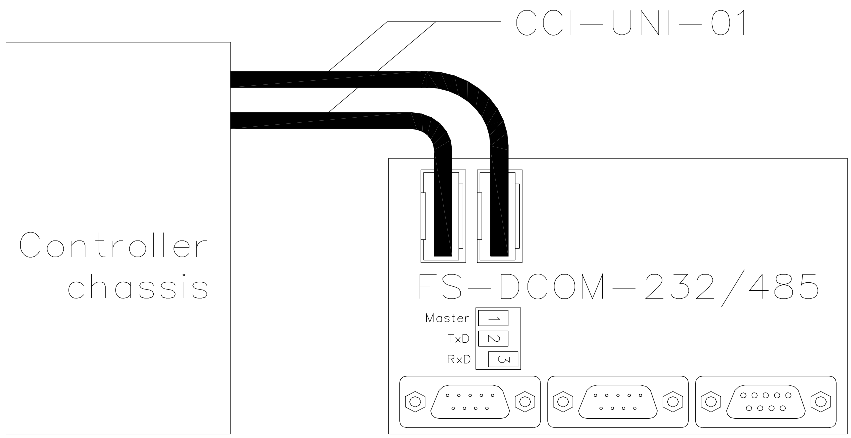


Figure 461 on page 738 shows the redundant connection to Control Processor 1 and Control Processor 2.

Figure 461 Redundant internal communication wiring to a DCOM-232/485 module



A connection is made by connecting one or two CCI-UNI-01 cables (see “CCI-UNI-0x” on page 745). The other ends are connected to 10-pin male connectors on the SM Controller backplane (see Table 7 on page 94).

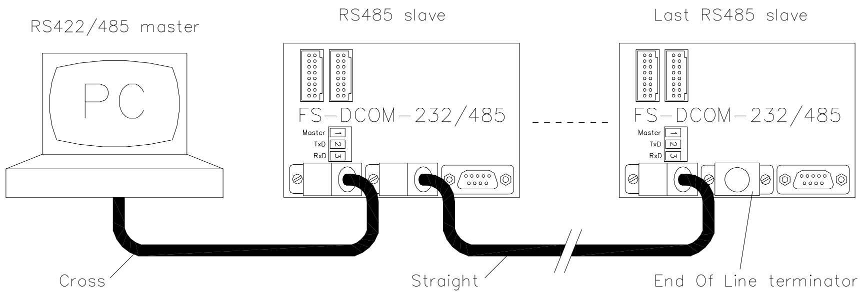
- The RS232 or RS485 connections of a non-redundant Control Processor require one internal cable (see Figure 460 on page 738).
- The RS232 connections of a redundant Control Processor require redundant internal cabling (see Figure 461 on page 738).
- The RS485 connections of a redundant Control Processor can consist of redundant internal cabling (which only requires one DCOM-232/485 module) or redundant external cabling (which requires two DCOM-232/485 modules).

Full duplex RS485 wiring examples

RS485 connection between Safety Station and Safety Manager(s)

Figure 462 on page 740 shows a wiring example for a full duplex RS485 link between a Safety Station (PC) and one or more (DCOM-232/485 modules of) Safety Manager(s).

Figure 462 RS485 link between a PC master and multiple Safety Manager slaves



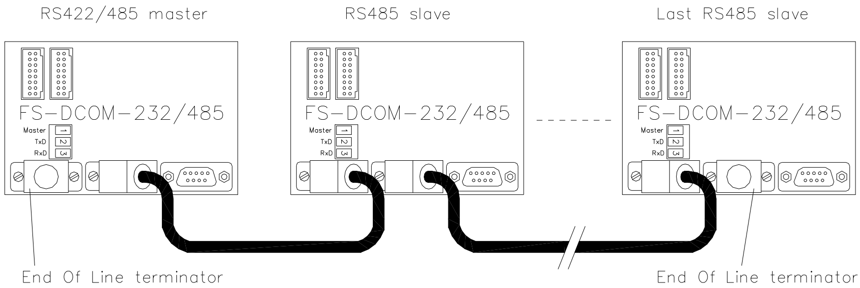
In Figure 462 on page 740:

- The used cable marked ‘cross’ is the CCE-485-02/Lx (see “CCE-485-02/Lx” on page 755).
- All other cables (between slaves) are the CCE-485-01/Lx (see “CCE-485-01/Lx” on page 753).
- The end of line terminator on the last DCOM-232/485 is the EOL-485-01 (see “EOL-485-01” on page 769).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cables or EOL) may be interchanged.
- All three dip switches on all DCOM-232/485 modules must be `Off`.

RS485 connection between master and slave Safety Managers

Figure 463 on page 741 shows a wiring example for a full duplex RS485 link between (the DCOM-232/485 modules of) an Safety Manager master and one or more (DCOM-232/485 modules of) slave Safety Manager(s).

Figure 463 RS485 link between a master Safety Manager and multiple Safety Manager slaves



In Figure 463 on page 741:

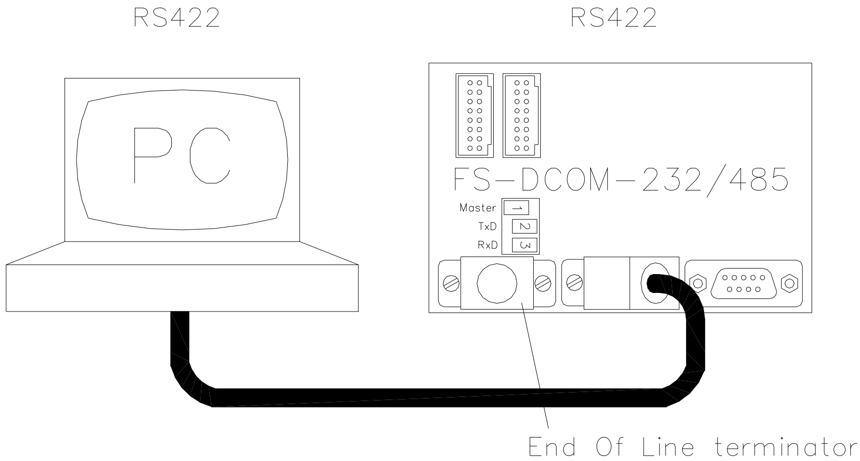
- The used cables are the CCE-485-01/Lx (see “CCE-485-01/Lx” on page 753).
- The end of line terminators on the DCOM-232/485 modules of the master and the last slave are the EOL-485-01 (see “EOL-485-01” on page 769).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cables or EOL) may be interchanged.
- All dip switches on the master DCOM-232/485 must be `On`.
- All dip switches on the slave DCOM-232/485 module(s) must be `Off`.

RS422 wiring examples

RS422 connection between Safety Station and Safety Manager

Figure 464 on page 742 shows a wiring example for an RS422 link between a Safety Station (PC) and the DCOM-232/485 module of Safety Manager.

Figure 464 RS422 link from PC to Safety Manager



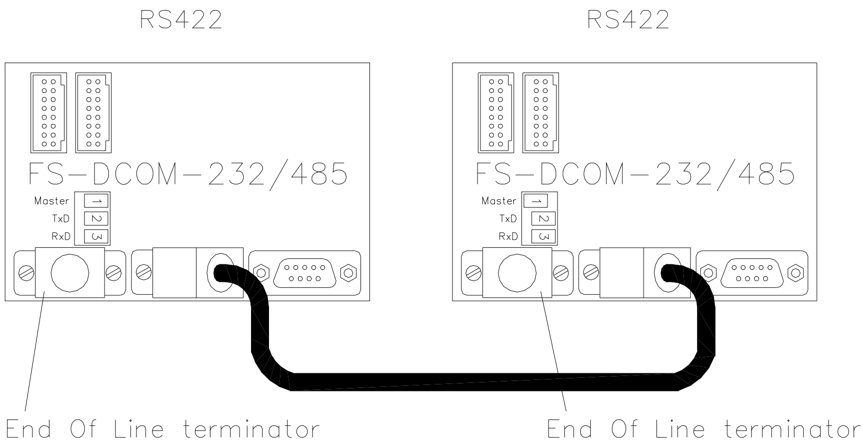
In Figure 464 on page 742:

- The used cable is the CCE-485-02/Lx (see “CCE-485-02/Lx” on page 755).
- The end of line terminator on the DCOM-232/485 is the EOL-485-01 (see “EOL-485-01” on page 769).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cable and EOL) may be interchanged.
- Dip switch 1 (Master) on the DCOM-232/485 must be `Off`.
- The dip switches 2 (TxD) and 3 (RxD) on the DCOM-232/485 must be `On`.

RS422 connection between master and slave Safety Manager

Figure 465 on page 743 shows a wiring example for an RS422 link between (the two DCOM-232/485 modules of) two Safety Managers.

Figure 465 RS422 link between two Safety Manager systems



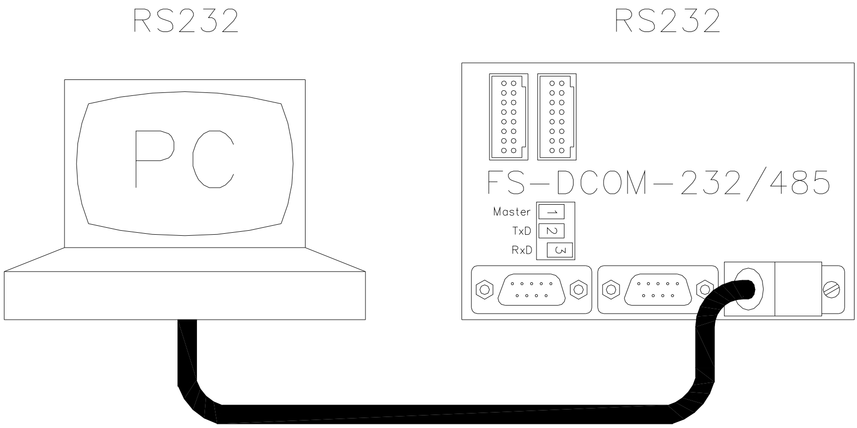
In Figure 465 on page 743:

- The used cable is the CCE-485-01/Lx (see “CCE-485-01/Lx” on page 753).
- The end of line terminators are EOL-485-01 (see “EOL-485-01” on page 769).
- The two (used) connectors on the DCOM-232/485 are functionally identical, so the connectors (cable and EOL) may be interchanged.
- Dip switch 1 (Master) must be:
  - `On` on the first DCOM-232/485
  - `Off` on the second DCOM-232/485.
- The dip switches 2 (TxD) and 3 (RxD) on the DCOM-232/485 must be `On`.

RS232 wiring examples

Figure 466 on page 744 shows a wiring example for an RS232 link between a development station (PC) and the DCOM-232/485 module of Safety Manager.

Figure 466 RS232 link from PC to Safety Manager



In Figure 466 on page 744:

- The used cable is the CCE-232-02/Lx (see “CCE-232-02/L10” on page 751).
- Dip switches 1 (Master) and 2 (TxD) on the DCOM-232/485 must be `Off`.
- Dip switch 3 (RxD) must be `On`.

CCI-UNI-0x

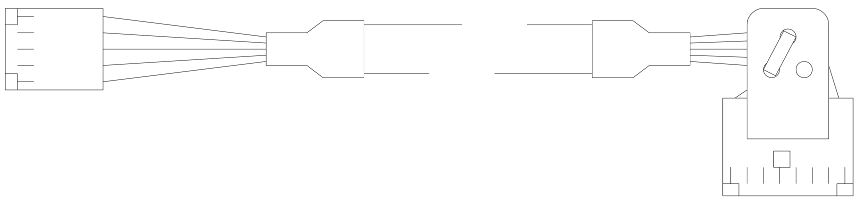
Description

The CCI-UNI-01 and CCI-UNI-02 are internal communication cables that connect a general purpose channel of the Safety Manager Universal Safety Interface (USI-0001 or USI-0002) to the communication FTA (DCOM-232/485).

- .For more information on the Universal Safety Interface, see section “USI-0001” on page 266 or “USI-0002” on page 271.
- For more information on the Communication FTA, see section “DCOM-232/485” on page 675.

Figure 467 on page 745 shows the connectors of a CCI-UNI-01 or CCI-UNI-02 cable.

Figure 467 connectors of a CCI-UNI-0x cable



Connector on Control Processor side   Connector on communication FTA side

Technical data CCI-UNI-01

General	Type number:	FS-CCI-UNI-01
	Approval:	UL, CSA, FM
Cable	Type:	BELDEN 8105 5x2 CORE SHIELD
	Length:	3 m
Connectors	Control Processor side: (USI-0001 or USI-0002)	10-pins
	DCOM-232/485 side:	16-pins

Technical data CCI-UNI-02

General	Type number:	FS-CCI-UNI-02
	Approval:	UL, CSA, FM
Cable	Type:	BELDEN 8105 5x2 CORE SHIELD
	Length:	2 m
Connectors	Control Processor side: (USI-0001 or USI-0002)	10-pins
	DCOM-232/485 side:	16-pins

CCI-HSE-0x

Description

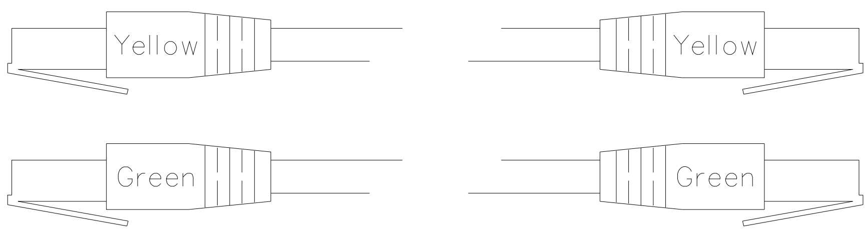
The CCI-HSE-01 and CCI-HSE-02 are cable sets, each consisting of a pair of shielded internal communication cables, used for High Speed Ethernet (HSE) connections.

Each pair consists of a yellow and a green color coded STP cable. Each pair is connects the high-speed ethernet channels of the Universal Safety Interface (USI-0001 or USI-0002) to a galvanically isolated Ethernet interface (an approved switch or alike).

- For more information on the Universal Safety Interface, see section “USI-0001” on page 266 or “USI-0002” on page 271.
- For more information on approved galvanically isolated HSE interfaces see Table 73 on page 503.

The CCI-HSE-01 and CCI-HSE-02 STP cable sets are Experion™ FTE compatible.

Figure 468 The CCI-HSE-0x shielded cable set



Technical data CCI-HSE-01

General	Type number:	FS-CCI-HSE-01
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	3 m
Connectors	Both sides:	RJ45

Technical data CCI-HSE-02

General	Type number:	FS-CCI-HSE-02
	Approvals:	UL, CSA, FM
Cables	Type:	CAT5PLUS STP (shielded twisted pair)
	Length (each cable):	2 m
Connectors	Both sides:	RJ45

CCE-232-01/L10

Description

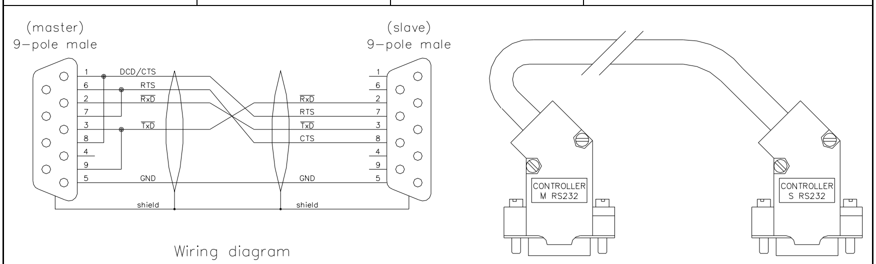
The CCE-232-01/L10 external communication cable is used for a full-duplex RS232 (no handshake) ‘point-to-point’ connection from a communication FTA (DCOM-232/485) to another communication FTA.

For more information on the Communication FTA, see section “DCOM-232/485” on page 675.

Signals

Figure 469 Pin assignment and layout of the CCE-232-01/L10 communication cable

Signal	9-p male (master)	9-p male (slave)	Color code
DCD/CTS	1, 8	7	white / blue stripe
RTS	6, 7	8	white / green stripe
–RxD	2	3	green / white stripe
–TxD	3, 9	2	blue / white stripe
GND	5	5	orange / white stripe



The Safety Manager communication FTA (DCOM-232/485) only uses pins 2, 3 and 5. This means that the ‘master’ connector as well as the ‘slave’ connector of the CCE-232-01/L10 may be placed on the Safety Manager communication FTA.

The handshake lines (and the master links to pins 6 and 9) are included to keep the cable compatible with the FSC-system RS232 cable.

Technical data

General	Type number:	FS-CCE-232-01/L10
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10 meter
Connectors	Both sides:	9 Pole sub-D male Metal housing: 45 deg.

CCE-232-02/L10

Description

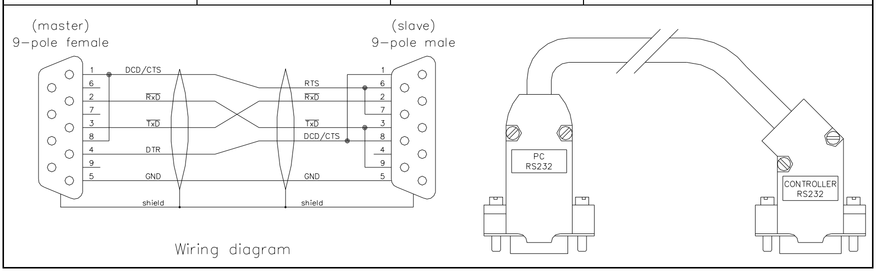
The CCE-232-02/L10 external communication cable is used for a full-duplex RS232 (no handshake) “point-to-point” connection between a “slave” Safety Manager communication FTA (DCOM-232/485) and the “master” Development System (DS) running on a PC.

For more information on the Communication FTA, see section “DCOM-232/485” on page 675.

Signals

Figure 470 Pin assignment and layout of the CCE-232-02/L10 communication cable

Signal	**9-p female (PC)**	**9-p male (slave)**	**Color code**
DCD/CTS	1, 8	6, 7	white / green stripe
–RxD	2	3, 9	blue / white stripe
–TxD	3	2	green / white stripe
DTR	4	1, 8	white / blue stripe
GND	5	5	orange / white stripe



The Safety Manager communication FTA (DCOM-232/485) only uses pins 2, 3 and 5.

The handshake lines (and the slave links to pins 6 and 9) are included to keep the cable compatible with the FSC-system RS232 cable.

Technical data

General	Type number:	FS-CCE-232-02/L10
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10 meter
Connectors	Master side:	9 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D male Metal housing: 45 deg.

CCE-485-01/Lx

Description

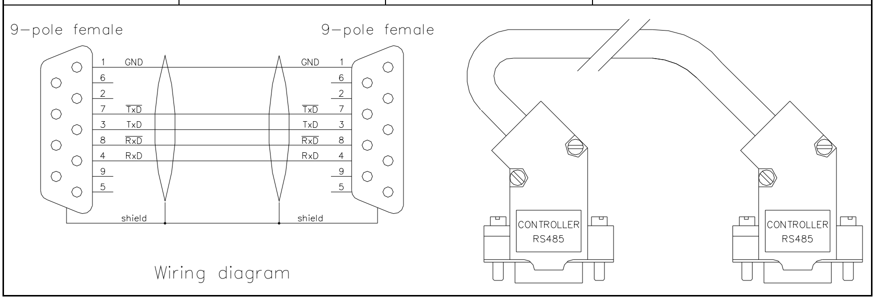
The CCE-485-01/Lx external communication cable is used for

- Full-duplex (RS485) connection between Safety Manager communication FTAs (“DCOM-232/485” on page 675) from “master” to “slave” or between slaves.
- RS422 “point-to-point” connection between two communication FTAs (“DCOM-232/485” on page 675).

Signals

Figure 471 Pin assignment and layout of the CCE-485-01/Lx communication cable

Signal	9-p Female	9-p Female	Color code
GND	1	1	orange / white stripe
+TxD	3	3	white / blue stripe
+RxD	4	4	white / green stripe
–TxD	7	7	blue / white stripe
–RxD	8	8	green / white stripe



Technical data

General	Type number:	FS-CCE-485-01/L10 (10 meter) FS-CCE-485-01/L25 (25 meter) FS-CCE-485-01/L50 (50 meter) FS-CCE-485-01/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 CORE SHIELD
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	Both sides:	9 Pole sub-D female Metal housing: 45 deg.

CCE-485-02/Lx

Description

The CCE-485-02/Lx external communication cable is used for:

- Full-duplex connection between a PC (Blackbox IC113C/133C)(RS485/422 ‘master’) and the first Safety Manager communication FTA (DCOM-232/485)(RS485 ‘slave’).
- RS422 ‘point to point’ connection between a PC (Blackbox IC113C/133C) and a Safety Manager communication FTA (DCOM-232/485).

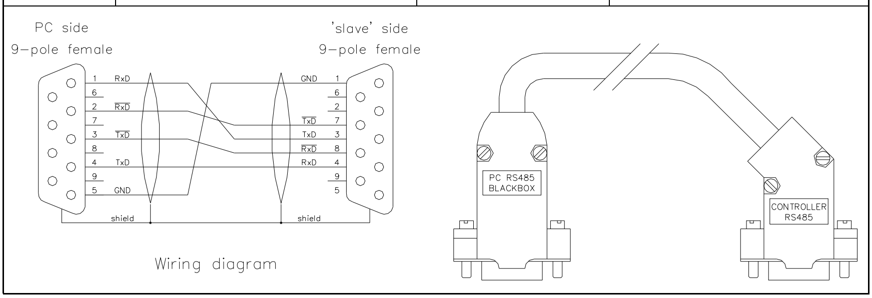
If only one Safety Manager is used, then this connection is a ‘point-to-point’ connection. If multiple Safety Managers are used, then the PC takes the role of master and the communication FTA the role of slave (this communication FTA is then connected to the other communication FTAs in a “in-between-slaves” connection using a CCE-485-01/Lx cable).

For more information on the Communication FTA, see section “DCOM-232/485” on page 675.

Signals

Figure 472 Pin assignment and layout of the CCE-485-02/Lx communication cable

Signal	9-p Female (PC)	9-p Female (slave)	Color code
+RxD	1	3	white / blue stripe
–RxD	2	7	blue / white stripe
–TxD	3	8	green / white stripe
+TxD	4	4	white / green stripe
GND	5	5	orange / white stripe



Technical data

General:	Type number:	FS-CCE-485-02/L10 (10 meter) FS-CCE-485-02/L25 (25 meter) FS-CCE-485-02/L50 (50 meter) FS-CCE-485-02/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	Master side:	9 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

CCE-485-04/Lx

Description

The CCE-485-04/Lx external communication cable is used for:

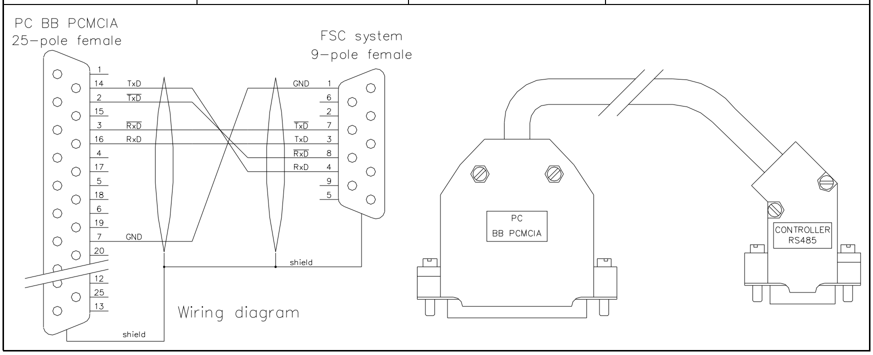
- Full-duplex connection between a PC (Blackbox IC114A) (RS485/422 ‘master’) and the first Safety Manager communication FTA (DCOM-232/485) (RS485 ‘slave’).
- RS422 ‘point-to-point’ connection between a PC (Blackbox IC114A) and a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see “DCOM-232/485” on page 675.

Signals

Figure 473 Pin assignment and layout of the CCE-485-04/Lx communication cable

Signal	25-p Female (master)	9-p Female (slave)	Color code
+TxD	14	4	white / green stripe
–TxD	2	8	green / white stripe
–RxD	3	7	blue / white stripe
+RxD	16	3	white / blue stripe
GND	7	1	orange / white stripe



Technical data

General	Type number:	FS-CCE-485-04/L10 (10 meter) FS-CCE-485-04/L25 (25 meter) FS-CCE-485-04/L50 (50 meter) FS-CCE-485-04/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	PC side:	25 Pole sub-D female Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

CCE-485-05/Lx

Description

The CCE-485-05/Lx external communication cable is used for:

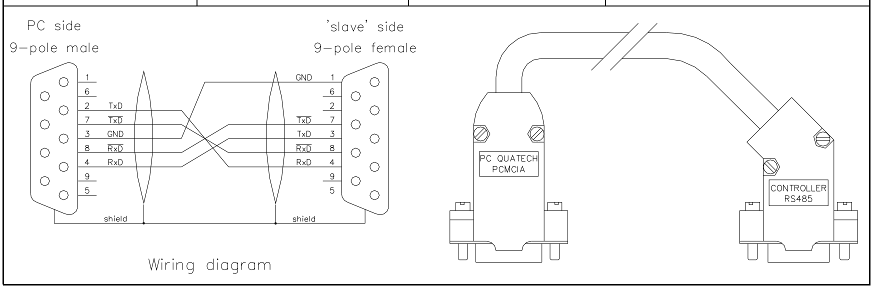
- Full-duplex connection between a PC (Quatech SSP/200/300) (RS485/422 ‘master’) and the first Safety Manager communication FTA (DCOM-232/485) (RS485 ‘slave’).
- RS422 ‘point-to-point’ connection between a PC (Quatech SSP/200/300) and a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see “DCOM-232/485” on page 675.

Signals

Figure 474 Pin assignment and layout of the CCE-485-05/Lx communication cable

Signal	9-p Male (master)	9-p Female (slave)	Color code
+TxD	2	4	white / green stripe
–TxD	7	8	green / white stripe
GND	3	1	orange / white stripe
–RxD	8	7	blue / white stripe
+RxD	4	3	white / blue stripe



Technical data

General	Type number:	FS-CCE-485-05/L10 (10 meter) FS-CCE-485-05/L25 (25 meter) FS-CCE-485-05/L50 (50 meter) FS-CCE-485-05/L100 (100 meter)
	Approvals:	UL, CSA, FM
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	10, 25, 50, 100 meter
	Impedance:	100 Ω
Connectors	PC side:	9 Pole sub-D male Metal housing: straight
	Slave side:	9 Pole sub-D female Metal housing: 45 deg.

CCE-485-FO-01/Lx

Description

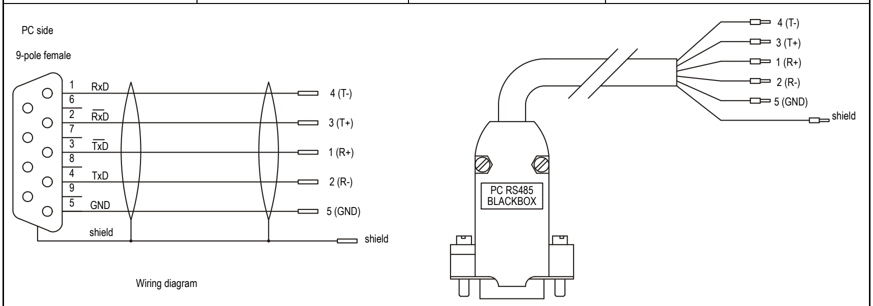
The CCE-485-FO-01/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a PC (Blackbox IC113C/133C) with a field-cable.
- RS422 ‘point-to-point’ connection between a PC (Blackbox IC113C/133C) with a field-cable.

Signals

Figure 475 Pin assignment and layout of the CCE-485-FO-01/Lx communication cable

Signal	9-p Female (PC)	Sleeve text	Color code
+RxD	1	4 (T–)	white / blue stripe
–RxD	2	3 (T+)	blue / white stripe
–TxD	3	1 (R+)	green / white stripe
+TxD	4	2 (R–)	white / green stripe
GND	5	5 (GND)	orange / white stripe
shield	housing	shield	-



Technical data

General	Type number:	FS-CCE-485-FO-01/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: straight
Wire ends	Pins:	8 mm < 1 mm^2
	Strip length:	approx. 24 cm (shield) approx. 9 cm (others)

CCE-485-FO-02/Lx

Description

The CCE-485-FO-02/Lx external communication cable is used for:

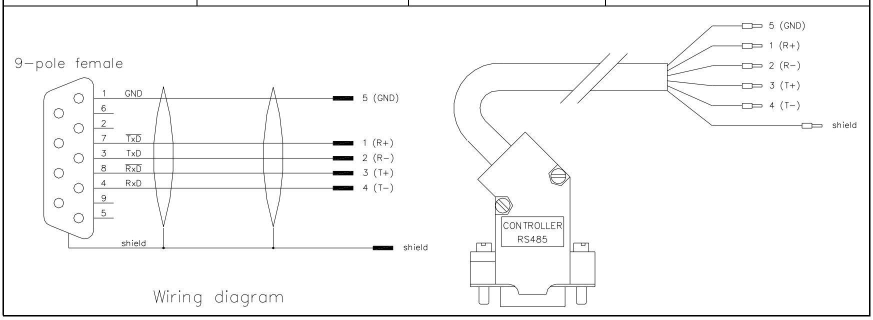
- Full-duplex RS485/422 connection of a Safety Manager communication FTA (DCOM-232/485) with a field-cable.
- RS422 ‘point-to-point’ connection of a Safety Manager communication FTA (DCOM-232/485) with a field-cable.

For more information on the Communication FTA, see “DCOM-232/485” on page 675.

Signals

Figure 476 Pin assignment and layout of the CCE-485-FO-02/Lx communication cable

Signal	9-p Female	Sleeve text	Color code
GND	1	5 (GND)	orange / white stripe
–TxD	7	1 (R+)	blue / white stripe
+TxD	3	2 (R–)	white / blue stripe
–RxD	8	3 (T+)	green / white stripe
+RxD	4	4 (T–)	white / green stripe
shield	housing	shield	-



Technical data

General	Type number:	FS-CCE-485-FO-02/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.
Wire ends	Pins:	8 mm < 1 mm^2
	Strip length:	approx. 24 cm (shield) approx. 9 cm (others)

CCE-485-FO-03/Lx

Description

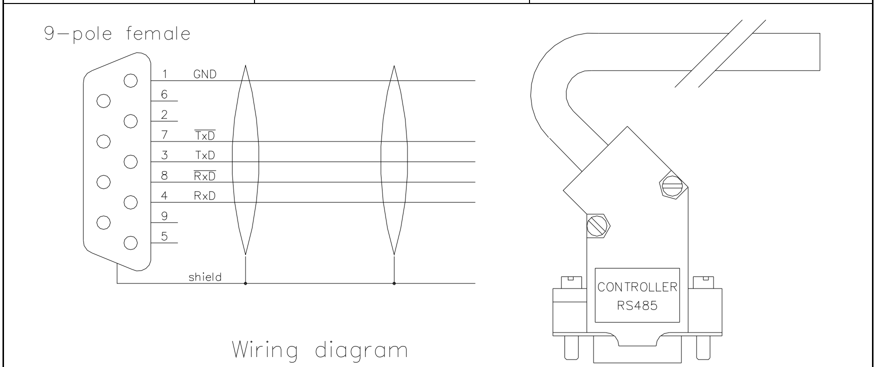
The CCE-485-FO-03/Lx external communication cable is used for:

- Full-duplex RS485/422 connection of a PC (Westermo MD63).
- RS422 ‘point-to-point’ connection of a PC (Westermo MD63).

Signals

Figure 477 Pin assignment and layout of the CCE-485-FO-03/Lx communication cable

Signal	9-p Female	Color code
GND	1	orange / white stripe
–TxD	7	blue / white stripe
+TxD	3	white / blue stripe
–RxD	8	green / white stripe
+RxD	4	white / green stripe
shield	housing	-



Technical data

General	Type number:	FS-CCE-485-FO-03/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.

CCE-485-FO-04/Lx

Description

The CCE-485-FO-04/Lx external communication cable is used for:

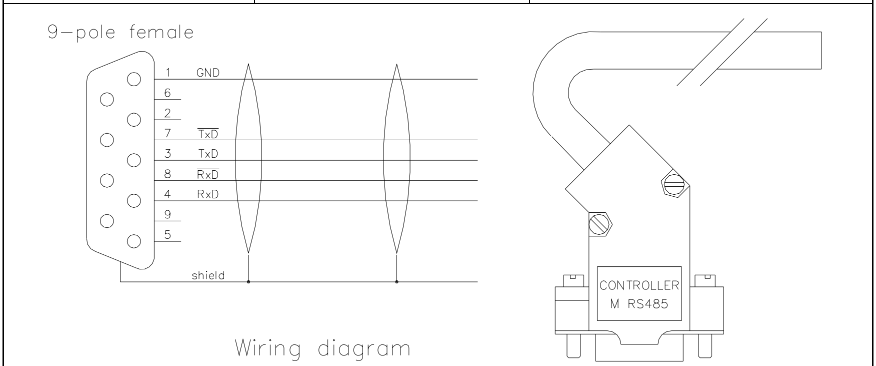
- Full-duplex RS485/422 connection of a Safety Manager communication FTA (DCOM-232/485).
- RS422 'point-to-point' connection of a Safety Manager communication FTA (DCOM-232/485).

For more information on the Communication FTA, see "DCOM-232/485" on page 675.

Signals

Figure 478 Pin assignment and layout of the CCE-485-FO-04/Lx communication cable

Signal	9-p Female	Color code
GND	1	orange / white stripe
–TxD	7	blue / white stripe
+TxD	3	white / blue stripe
–RxD	8	green / white stripe
+RxD	4	white / green stripe
shield	housing	-



Technical data

General	Type number:	FS-CCE-485-FO-04/Lx
	Approvals:	UL, CSA
Cable	Type:	BELDEN 8103 3x2 core shield
	Length:	× meter (user defined)
	Impedance:	100 Ω
Connectors		9 Pole sub-D female Metal housing: 45 deg.

EOL-485-01

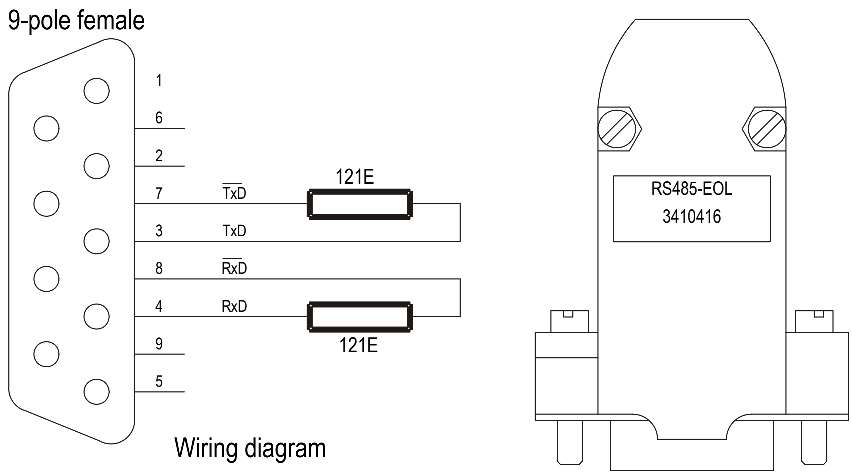
Dual 120 Ω end of line terminator

Description

The dual 120 Ω End Of Line terminator (EOL-485-01) is used as line terminator for RS422 or RS485 connections that end on the Safety Manager communication FTA (DCOM-232/485).

They are placed on the vacant RS485 connector position of a communication FTA (see section “DCOM-232/485” on page 675).

Figure 479 Side view of the EOL-485-01



Technical data

General	Type number:	FS-EOL-485-01
	Approvals:	n/a
Physical	Module dimensions:	31 × 16.5 × 46.5 mm (L × W × H) 1.22 × 0.65 × 1.83 in (L × W × H)
Electrical	Resistors:	121 Ω, 1%, 0.5 W
	Connector:	9-pole sub-D female

Power distribution

18

This chapter describes various types of power distribution modules and cables which can be used for the power distribution in Safety Manager.

The following power distribution modules are described:

Power distribution modules	See
SIF-X; Supply Input Filters (SIF)	page 776
MB-0001; Mains power rail (24Vdc—110Vdc) with 10 sections	page 783
PDB-0824; Power Distribution Board (24Vdc, 2 Amp, 8 channel)	page 792
PDB-0824P; Power Distribution Board (24Vdc, 2 Amp, 8 channel)	page 796
PSU-FLTR2450; Common mode filter for the PSU-UNI2450	page 780

Power distribution cables	See
PDC-MBMB-1; Mains power distribution cable (24Vdc, 48Vdc)	page 800
PDC-CPSET; Power distribution cable set Control Processor (24Vdc)	page 802
PDC-IOSET; Power distribution cable set IO chassis (24Vdc, 48Vdc or 110Vdc)	page 804
PDC-CP24	page 807
PDC-IOxPx	page 809
PDC-MB24-x; Power Distribution Cable (24Vdc), -1, -2 and -3 cables	page 812
PDC-MB24-y; Power Distribution Cable (24Vdc), -1P, -2P and -3P cables	page 814
PDC-FTA24; Power Distribution Cable (24Vdc)	page 816

General info about the power distribution concept

Safety Manager main power wiring concepts are built around the MB-0001 mains power rail, power distribution cables (PDC cables) and power distribution boards (PDB boards).

- Mains power rails distribute the power from (multiple) redundant power supplies to the users.
- PDB power distribution boards enable easy distribution of 24Vdc from the mains power rail to individual devices inside the cabinet enclosure, such as fan units and FTAs.
- Standard PDC cables are used to connect the modules together.

Connecting power supplies to the mains power rail

Figure 480 Redundant PSU concept on an MB-0001 mains power rail

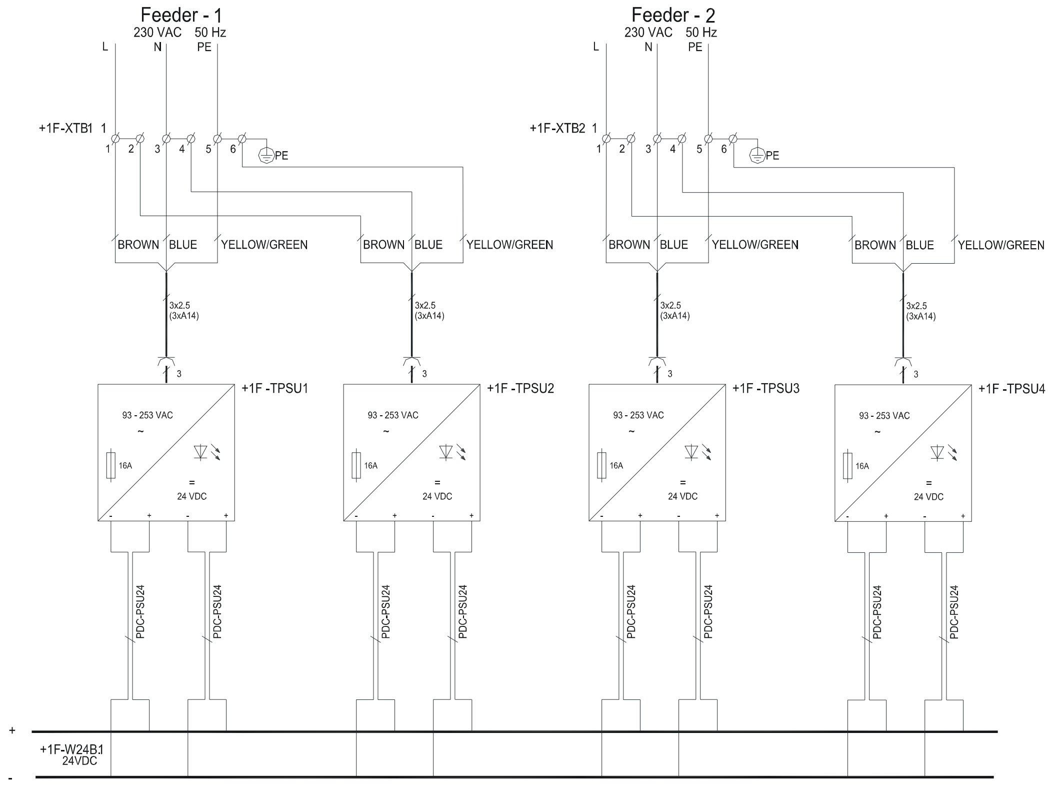


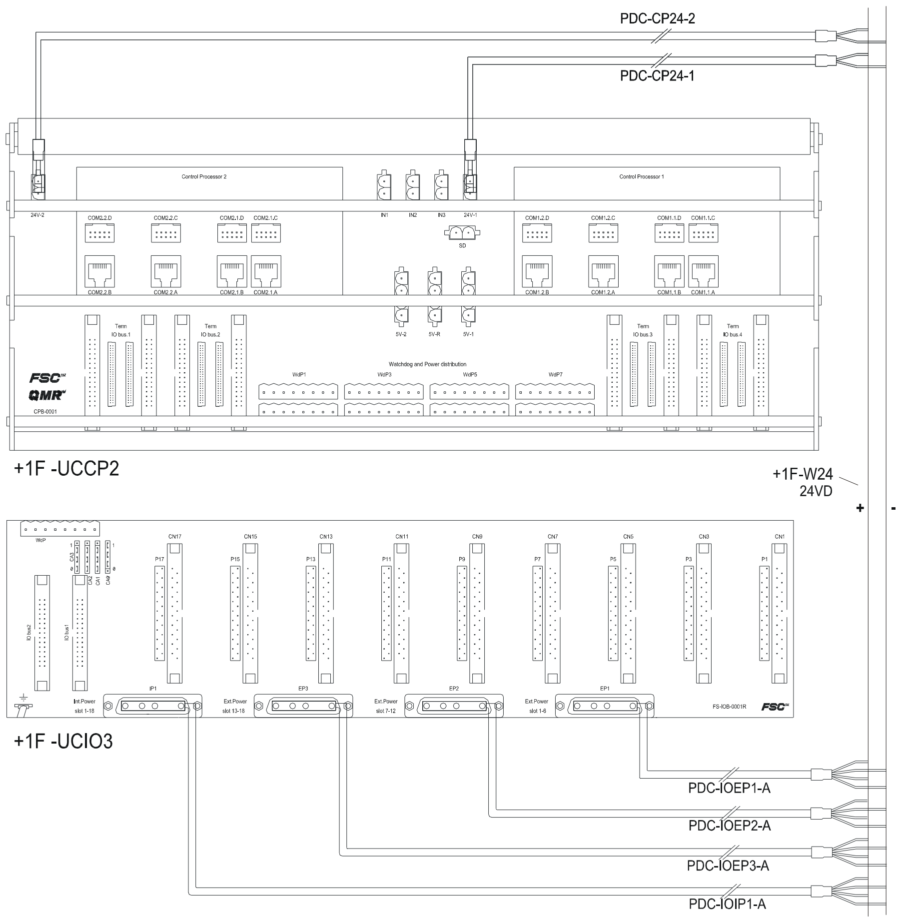
Figure 480 on page 772 shows an example of a redundant power supply concept feeding an MB-0001 mains power rail.

The concept is based on redundant feeders, PSU-UNI2450 PSU's, an MB-0001 mains power rail and PDC-MB24-x power distribution cables.

Connecting Controller and IO chassis to the mains power rail

Figure 481 on page 773 shows how a Controller chassis and a IO chassis are powered by an MB-0001 mains power rail; via dedicated PDC cables.

Figure 481 Controller chassis and IO chassis wired to an MB-0001 mains power rail



The Controller chassis receives its power via an PDC-CPSET power distribution cable-set (see "PDC-CPSET" on page 802). These cables connect the backplane of the chassis (connector 24V-1 supplies Control Processor 1 and connector 24V-2 supplies Control Processor 2) to the mains power rail.

The IO chassis receive their internal and external supply voltages (24 Vdc, 48 Vdc, or 110 Vdc) from the mains power rail via a set of PDC-IOSET power distribution cables (see “PDC-IOSET” on page 804 for details).

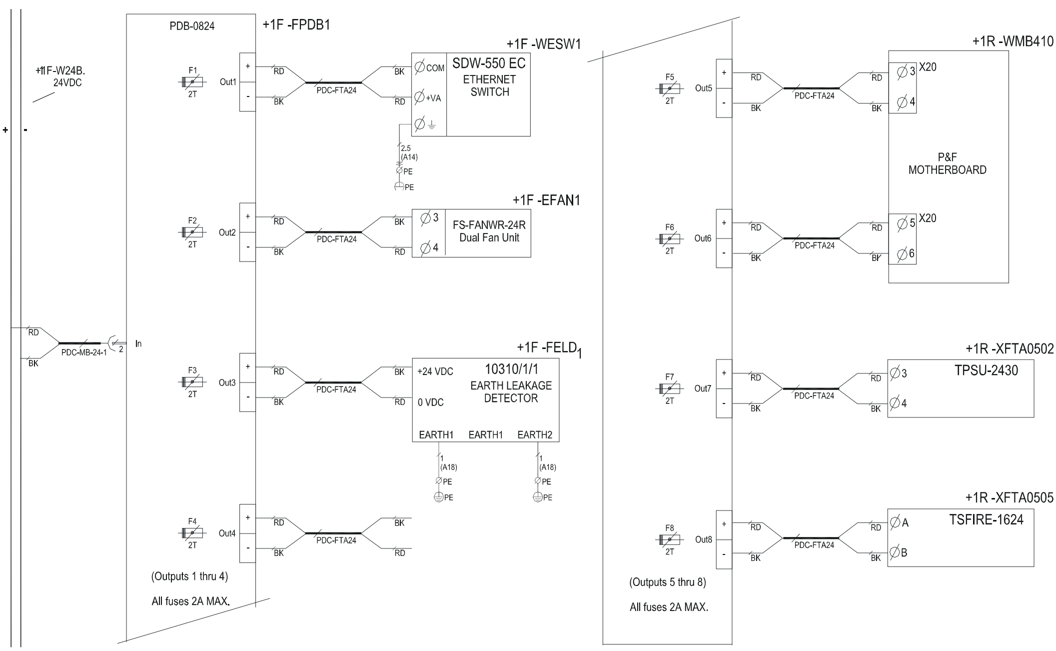
IO module slots	Power supply voltage	Cable
1-6	External	FS-PDC-IOEP1A
7-12	External	FS-PDC-IOEP2A
13-18	External	FS-PDC-IOEP3A
All	Internal	FS-PDC-IOIP1A

The 5 Vdc power distribution is not part of the main power distribution and is described in “5 Volt and watchdog distribution” on page 819.

Connecting to the mains power rail via the power distribution board

Figure 482 on page 774 shows an example of how 24 Vdc devices, requiring less than 2A (fan units, ELD’s, FTA’s, etc.), are powered by the MB-0001 mains power rail; via a PDB-0824 power distribution board and dedicated PDC cables.

Figure 482 Low power consumers wired to an MB-0001 mains power rail



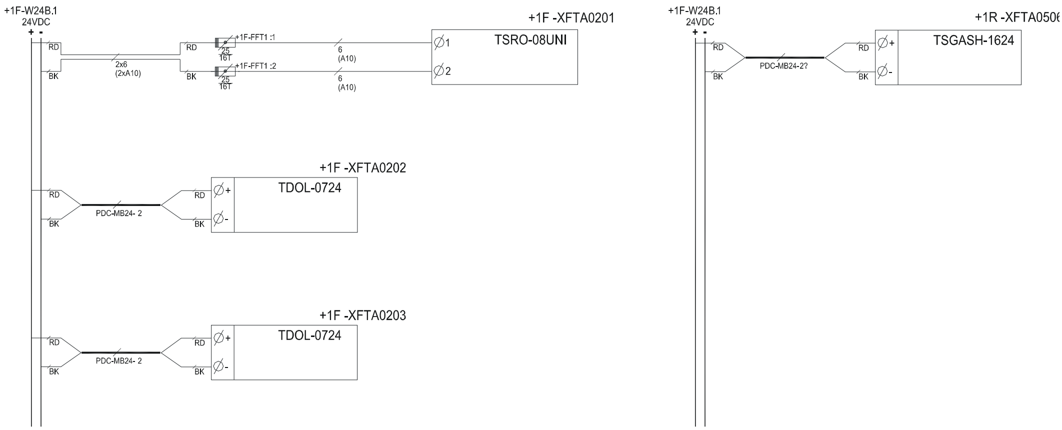
Connecting directly to the mains power rail

Note:

A dedicated mains power rail must be installed for each voltage used. For power options see “MB-0001” on page 783.

Figure 483 on page 775 shows how the remaining devices (24 Vdc devices requiring more than 2A or devices powered by voltages other than 24 Vdc) are powered by the MB-0001 mains power rail.

Figure 483 High power consumers wired to an MB-0001 mains power rail



SIF-X

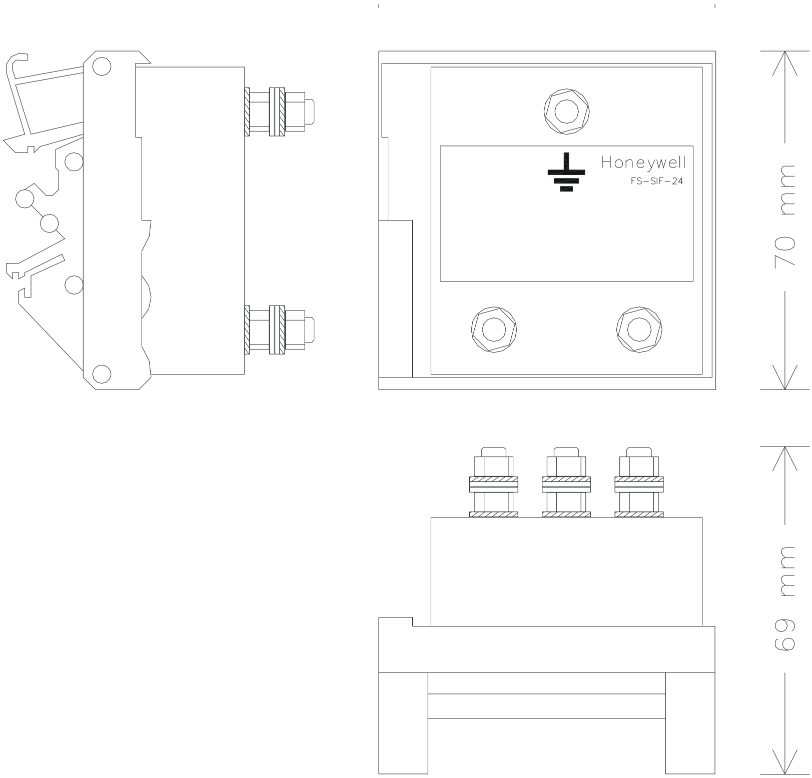
Supply Input Filters (SIF)

Description

The SIF-X modules are used as power supply input filters. The type of SIF-X module to be used depends on the voltage level:

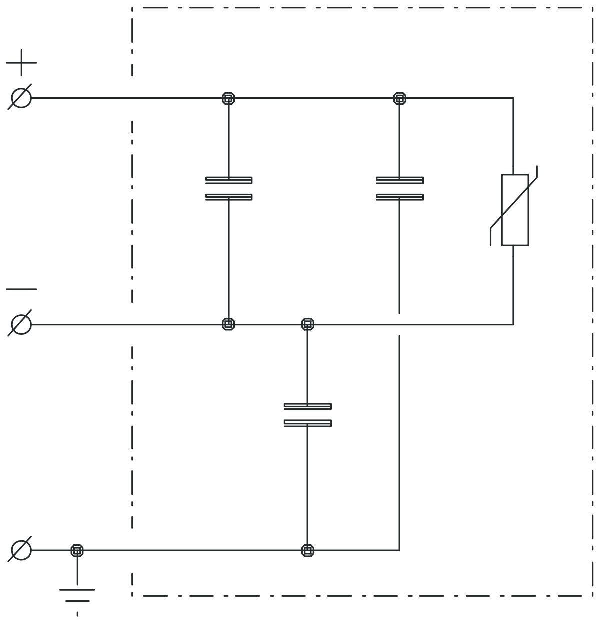
- 24 Vdc: FS-SIF-24
- 48 Vdc: FS-SIF-48
- 60 Vdc: FS-SIF-60
- 110 Vdc: FS-SIF-110

Figure 484 SIF-X mechanical layout



The SIF-X modules have a universal snap-in provision for standard DIN EN rails.

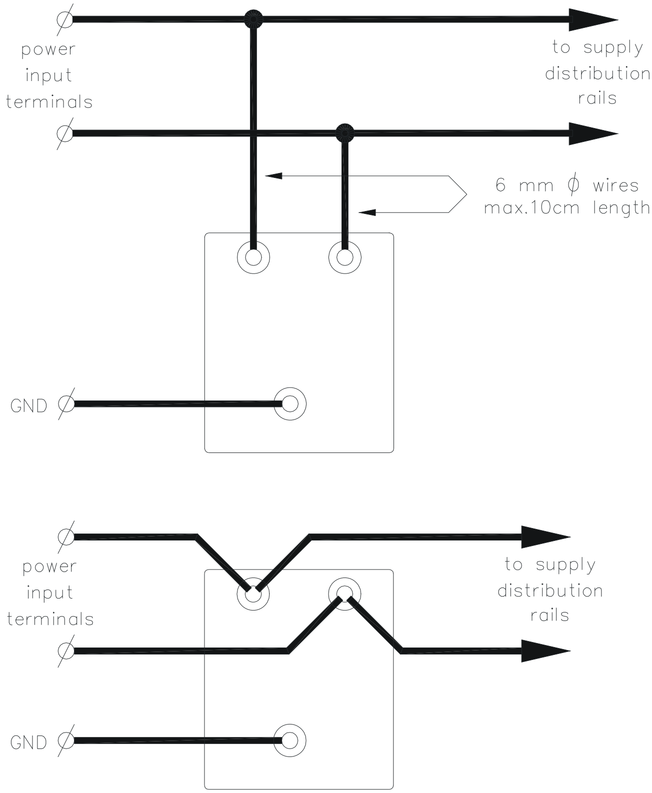
Figure 485 SIF-X circuit



If the DC power is supplied externally, the input filter must be placed close to the input terminals of the power supply. The plus (+) and minus (–) connections are arbitrary. The ground connection is indicated.

The supply wires must be routed via filter terminals, or they must be connected to the input filter using wires with a diameter of at least 6 mm² (AWG 10) and a maximum length of 10 cm (4 in).

Figure 486 Wiring examples for SIF-X modules



Technical data

The SIF-X modules have the following specifications:

General	Type number[1]:	24 Vdc: FS-SIF-24 48 Vdc: FS-SIF-48 60 Vdc: FS-SIF-60 110 Vdc: FS-SIF-110
	Approvals:	CE, CSA, UL; TUV, FM[2] pending
Physical	Dimensions:	70 × 70× 69 mm (L × W × H) 2.76 × 2.76 × 2.72 in (L × W × H)
	DIN EN rails:	TS32 / TS35 x 7.5
	Used rail length:	71 mm (2.80 in)
	Weight:	Approximately 130 gr. (4.18 oz.)
Power	Power requirements:	None
	Maximum voltage:	FS-SIF-24: 31Vdc FS-SIF-48: 55Vdc FS-SIF-60: 65Vdc FS-SIF-110: 125 Vdc
	Maximum voltage between any input and GND:	500 Vac or 700 Vdc
Terminations	Connection type:	M5

1 The SIF-X input supply filter types replace the10306/1/x input supply filter types which only have an UL approval up to 40°C. There are no functional changes.

2 FM approval applies to the FS-SIF-24 module type only.

PSU-FLTR2450

Common mode filter for the PSU-UNI2450

Description

The PSU-FLTR2450 module is a common mode filter that can be fitted on the PSU-UNI2450 V1.0 power supply, as described in “PSU-UNI2450” on page 8.

Note:

The PSU-FLTR2450 is mandatory for version 1.0 of the PSU-UNI2450.

The PSU-FLTR2450 has:

- two female connectors that slot in the 24V connectors of the PSU-UNI2450.
- two male connectors to connect the mains power rail via a dual cable set. (For more information see “MB-0001” on page 783.)
- a mounting bracket, to secure the filter on top of the mounting bracket located at the output side of the PSU-UNI2450.

Figure 487 on page 780 shows the front view of the PSU-FLTR2450.

Figure 487 PSU-FLTR2450 front view

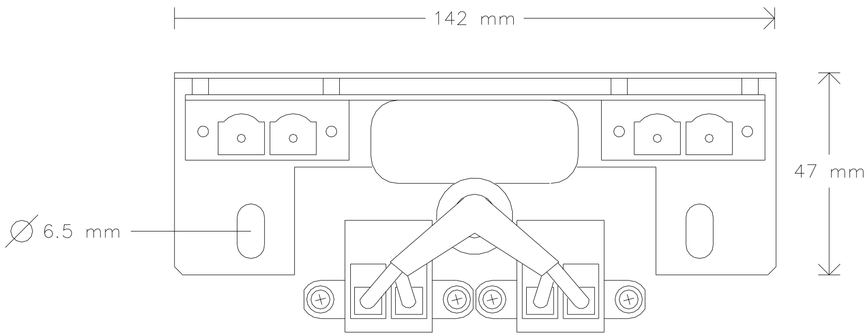
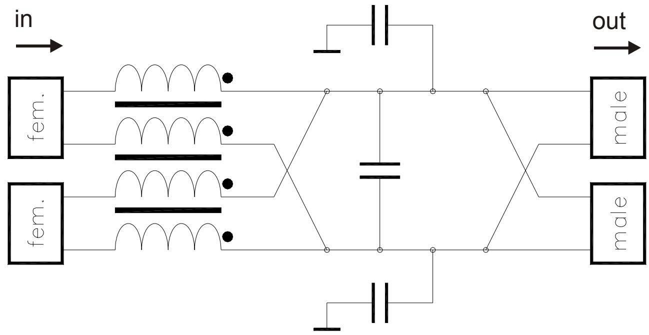


Figure 488 on page 781 contains a schematic diagram of the PSU-FLTR2450 common mode filter.

Figure 488 PSU-FLTR2450 schematic diagram

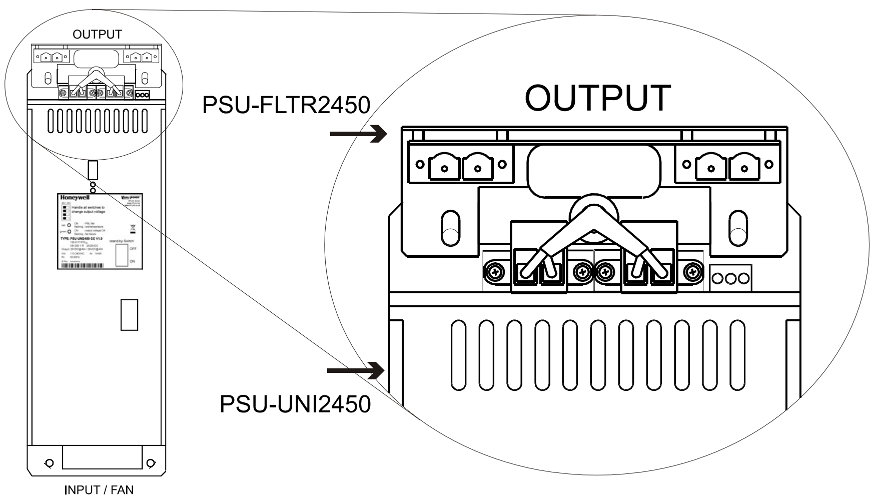


Connection and assembly instructions

Figure 489 on page 781 shows how the PSU-FLTR2450 filter module is installed to the PSU-UNI2450 power supply unit:

- Disconnect the 24 Vdc power cables and remove the two bolts securing the output side of the PSU-UNI2450 to the mounting plate.
- Slot the PSU-FLTR2450 in the 24V connectors of the PSU-UNI2450 and position the filter over the mounting brackets of the PSU-UNI2450.
- Secure the PSU-FLTR2450 to the PSU-UNI2450 and the mounting plate with the two bolts removed earlier, and reconnect the 24 Vdc power cables.

Figure 489 PSU-FLTR2450 connected to a PSU-UNI24520 V1.0



Technical data

The FC-PSU-FLTR2450 module has the following specifications:

General	Type number:	FC-PSU-FLTR2450
	Approvals[1]:	CE, TUV
Physical	Dimensions:	60 x 142 x 100 mm (L × W × H) 2.36 x 5.6 x 3.94 in (L × W × H)
	Mounting:	on PSU-UNI2450 mounting bracket with M6 bolts
	Weight:	Approximately 360 gr. (12.7oz.)
Power	Power requirements:	None
	Output power:	Complies with PSU-UNI-2450
	Maximum voltage between any input and GND:	500 Vac or 700 Vdc
Terminations	Output connector type:	2 x Phoenix PCV6-16 2G1F-10,16 male with locking screws

1 TUV approval pending. For updates contact Honeywell SMS.

MB-0001

Mains power rail (24Vdc—110Vdc) with 10 sections

Description

The MB-0001 mains power rail distributes a DC voltage in the range of 24Vdc—110Vdc from (multiple) redundant power supplies to its users.

The MB-0001 mains power rail has 120 connection points and can distribute up to 200 Amps. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in Figure 490 on page 783.

Figure 490 JCK and STR type connectors for the MB-0001

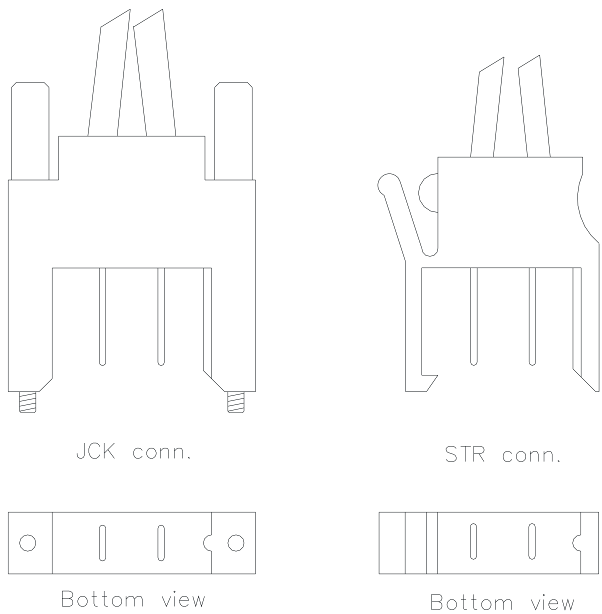


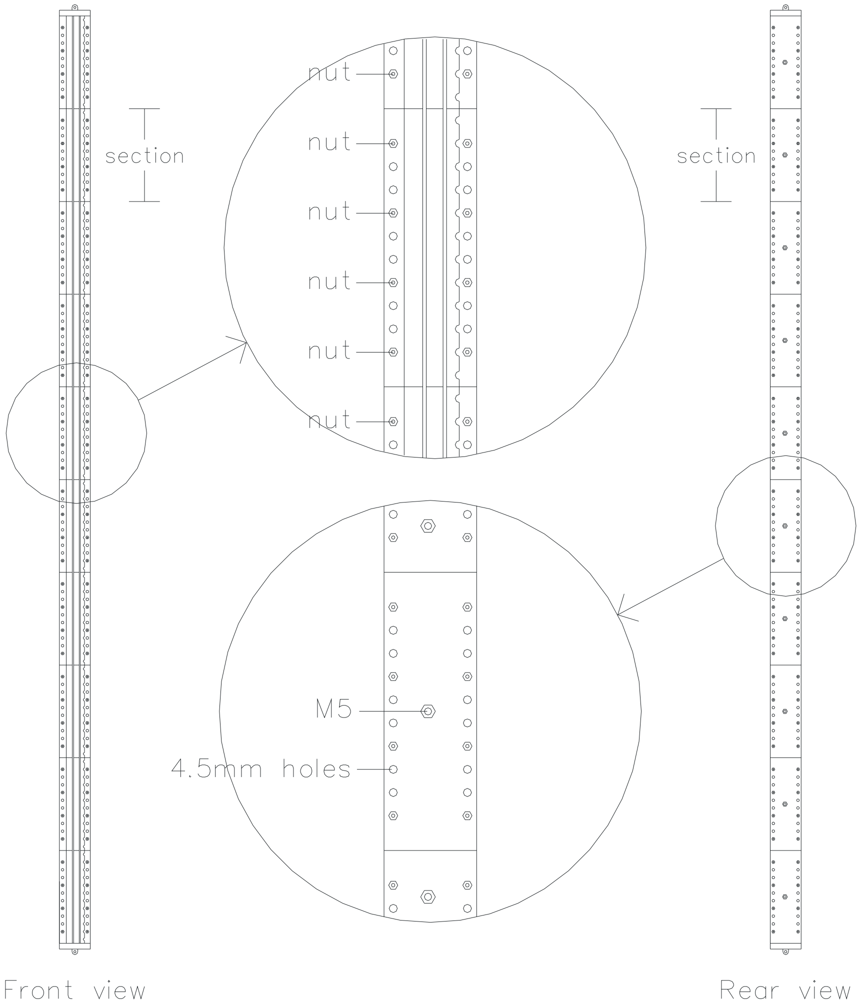
Figure 491 on page 784 shows that the MB-0001 mains power rail consists of:

- two copper rails,
- two end caps and
- ten 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

Figure 491 MB-0001 – 10 section power rail, front view and rear view



The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in Figure 491 on page 784.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

Technical data

General	Type number:	FS-MB-0001
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125 ºC (257 ºF)
	Temperature STR connector	max. 105 ºC (221 ºF)
Sections	quantity per rail	10
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	1563 x 5.08 x 34.8 mm (L x W x H) 61.52 x 2.0 x 1.37 in (L x W x H)
	Weight	3.7kg (8.16 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

MB-0002

Mains power rail (24Vdc—110Vdc) with 4 sections

Description

The MB-0002 mains power rail distributes a DC voltage in the range of 24Vdc—110Vdc from (multiple) redundant power supplies to its users.

The MB-0002 mains power rail has 48 connection points and can distribute up to 200 Amps. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in Figure 492 on page 786.

Figure 492 JCK and STR type connectors for the MB-0002

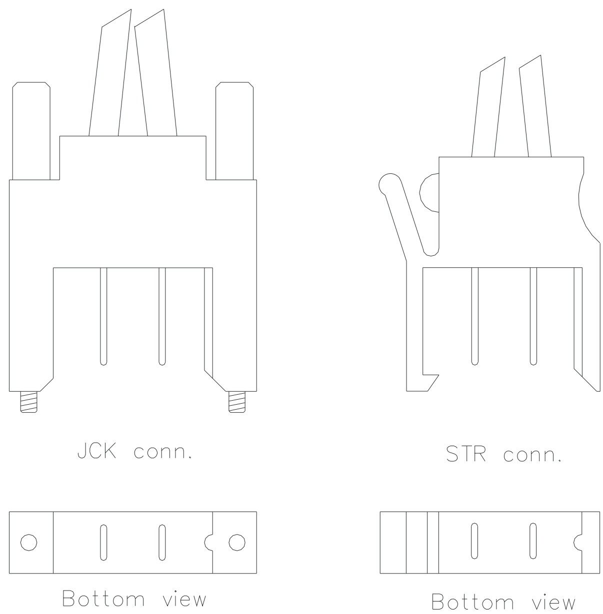


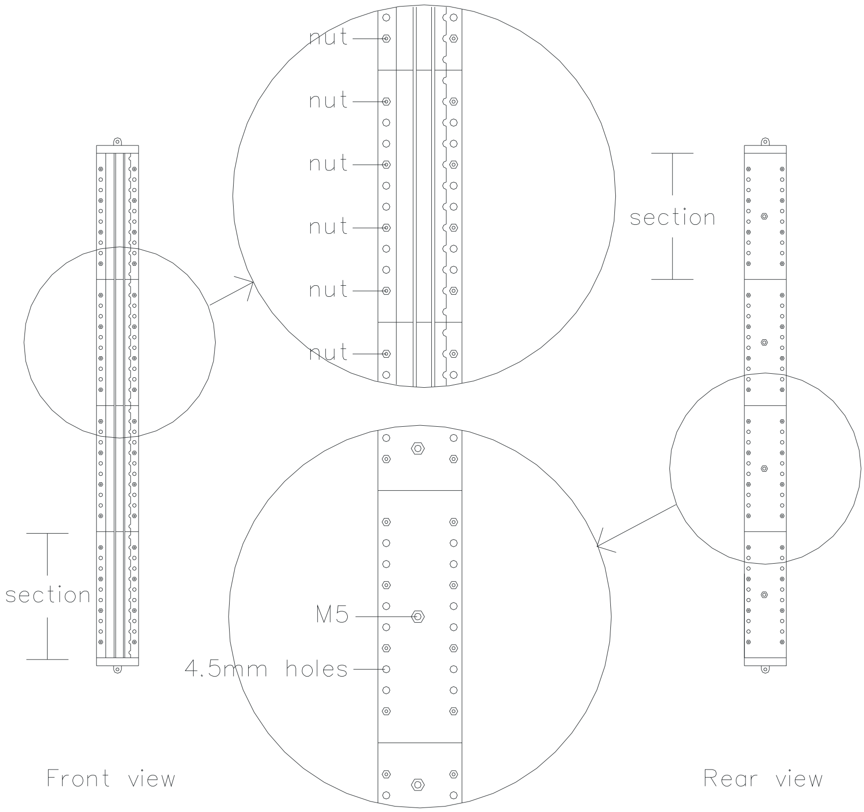
Figure 493 on page 787 shows that the MB-0002 mains power rail consists of:

- two copper rails,
- two end caps and
- four 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

Figure 493 MB-0002 – 4 section power rail, front view and rear view



The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in Figure 493 on page 787.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

Technical data

General	Type number:	FS-MB-0002
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125 ºC (257 ºF)
	Temperature STR connector	max. 105 ºC (221 ºF)
Sections	quantity per rail	4
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	649 x 5.08 x 34.8 mm (L x W x H) 25.52 x 2.0 x 1.37 in (L x W x H)
	Weight	1.5kg (3.3 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

MB-0003

Mains power rail (24Vdc—110Vdc)) with 6 sections

Description

The MB-0003 mains power rail distributes a DC voltage in the range of 24Vdc—110Vdc from (multiple) redundant power supplies to its users.

The MB-0003 mains power rail has 72 connection points and can distribute up to 200 Amps. Connection to the rail requires special connectors.

They may be of type Jackscrew (JCK) or of type Squeeze-To-Release (STR), as shown in Figure 494 on page 789.

Figure 494 JCK and STR type connectors for the MB-0003

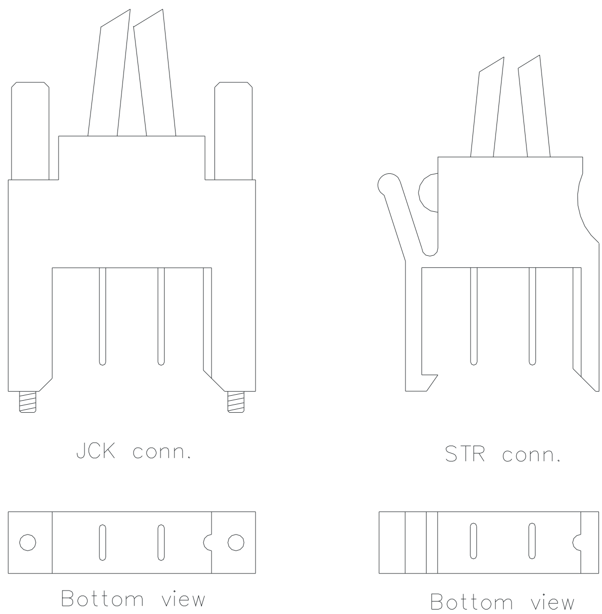


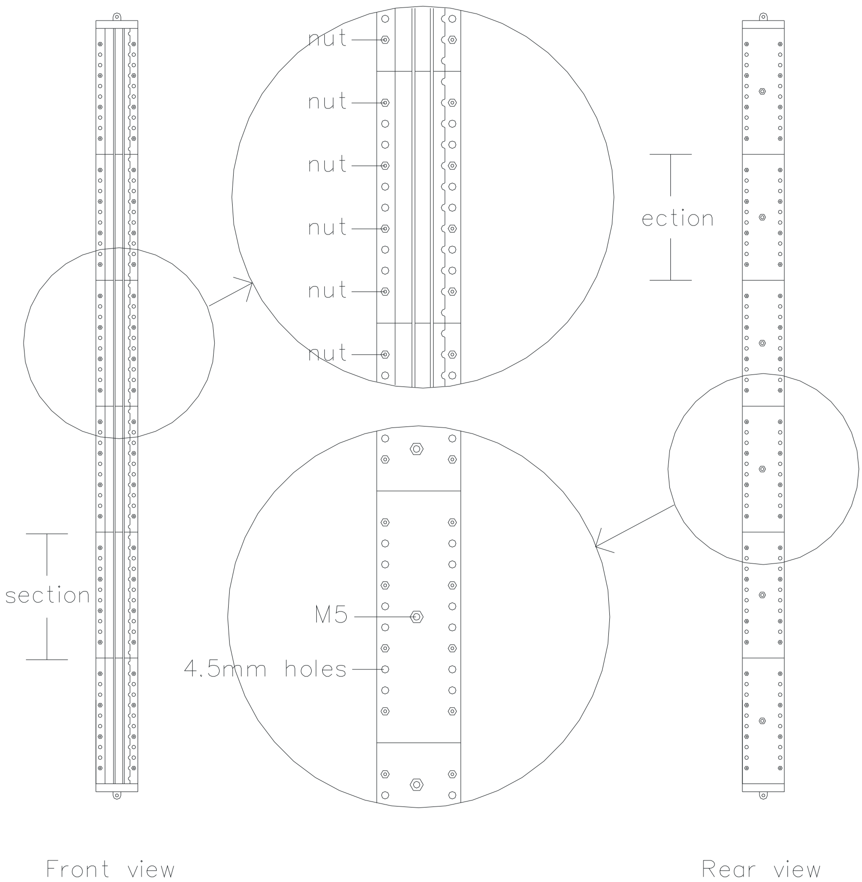
Figure 495 on page 790 shows that the MB-0003 mains power rail consists of:

- two copper rails,
- two end caps and
- ten 6 inch sections.

Each section has twelve connector positions.

- The second, fifth, eighth and the eleventh connector position of each section have nuts in the housing to accommodate for JCK connectors.
- All (twelve) positions (of each section) can be used for STR connectors.

Figure 495 MB-0003 – 6 section power rail, front view and rear view



The rail can be mounted using the M5 thread hole on the rear centre of the rail, as shown in Figure 495 on page 790.

Mounting without rear access is possible using the 4.5mm diameter holes on both sides of the rail and on each end cap.

Technical data

General	Type number:	FS-MB-0003
	Approvals:	UL, CSA, FM pending
Load	Rail current:	max. 200 A
Connectors	D-TAB-200-JCK	max. 55 A (with AWG 8 wire)
	D-TAB-200-STR	max. 25 A (with AWG 12 wire)
	Temperature rail and JCK connector	max. 125 ºC (257 ºF)
	Temperature STR connector	max. 105 ºC (221 ºF)
Sections	quantity per rail	6
	JCK positions per section	max 4
	STR positions per section	max 12
	length per section	152.4 mm (6 inch)
Physical	Rail dimensions	954 x 5.08 x 34.8 mm (L x W x H) 37.52 x 2.0 x 1.37 in (L x W x H)
	Weight	2.22 kg (4.9 lb)
	M5 mounting thread hole	6.5mm (0.256 inch) depth, 152.4mm (6 inch) mounting interval

PDB-0824

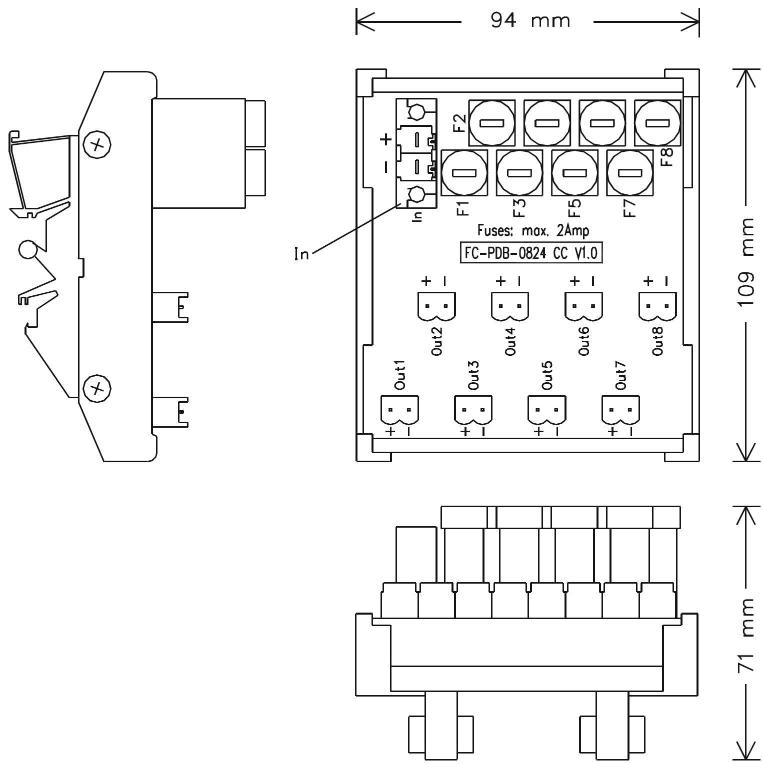
Power Distribution Board (24Vdc, 2 Amp, 8 channel)

Description

The PDB-0824 power distribution board enables easy distribution of 24Vdc from the main power rail to individual 24Vdc devices inside the cabinet enclosure, such as fan units and FTAs.

Figure 496 on page 792 shows the PDB-0824 board with one 24Vdc entry connector (In) for connection to the main bus bar and eight (2 Amp fused) 24Vdc field connectors (Out1 thru Out8) for connection to eight 24Vdc devices.

Figure 496 PDB-0824 board layout



A 24 Vdc power distribution cable (see data sheet “PDC-MB24-x” on page 812 for details) can be used to connect the main power bar to In.

- When using other connection cables make sure the wire size is adequate and a Weidmuller BVZ 7.62/02F SW connector with two keying pins is used to connect to In of the PDB-0824 (see “Pin allocation” on page 793).

24V distribution cables (see “PDC-FTA24” on page 816) connect the PDB-0824 with up to eight 24Vdc devices.

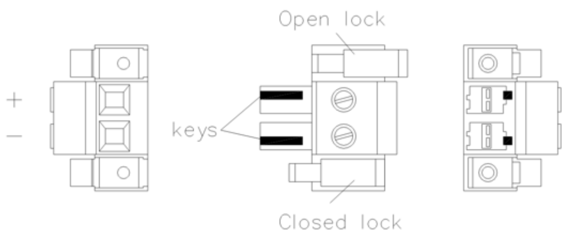
- When using other connection cables make sure the wire size is adequate and a Weidmuller BL 5.08/2 SN OR or equivalent connector is used to connect to one of the Outx connectors of the PDB-0824 (see “Pin allocation” on page 793).

Pin allocation

Figure 497 on page 793 shows the top, side & bottom view and the pin assignment of the Weidmuller BVZ 7.62/02F SW cable-connector on In.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the main bus bar

Figure 497 Power connector on In (Weidmuller BVZ 7.62/02F SW) top, side and bottom view

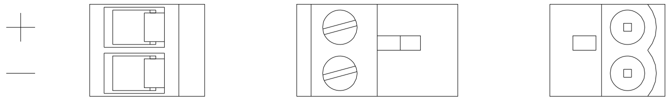


The two (orange) locking slides of the cable-connector in Figure 497 on page 793 keep the cable-connector locked when inserted into In.

Figure 498 on page 793 shows the top, side & bottom view and the pin assignment of the Weidmuller BL 5.08/2 SN OR or equivalent connector to an Outx field connector on the PDB-0824.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the consumer
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the consumer

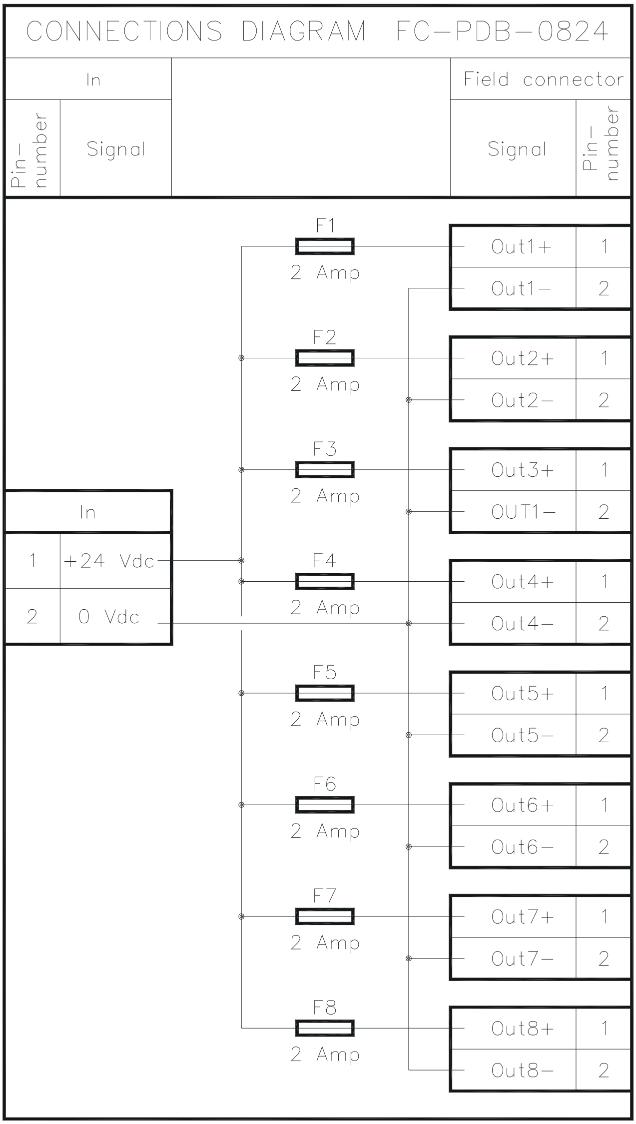
Figure 498 Power connector on Outx (Weidmuller BL 5.08/2 SN OR) top, side and bottom view



Connections

The connection diagram of the PDB-0824 module:

Figure 499 Connection diagram



Technical data

General	Type numbers[1] :	FC-PDB-0824 CC V1.0
	Approvals:	CE; UL, TUV, CSA pending
Fuses	rating	max. 2 AT (slow acting)
	dimensions:	5 x 20 mm (0.20 x 0.79 in)
Connectors	In make and type:	2 pole header with keying • Weidmuller: BVZ 7.62/02F SW (conn.) • Weidmuller: KO BV/SV7.62 (keys)
	Field connector make and type:	2 pole socket block Weidmuller: BL 5.08/2 SN OR
Physical	Module dimensions:	94 x 109 x 71 mm (L x W x H) 3.7 x 4.3 x 2.8 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	95 mm (3.74 in)

1 FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

PDB-0824P

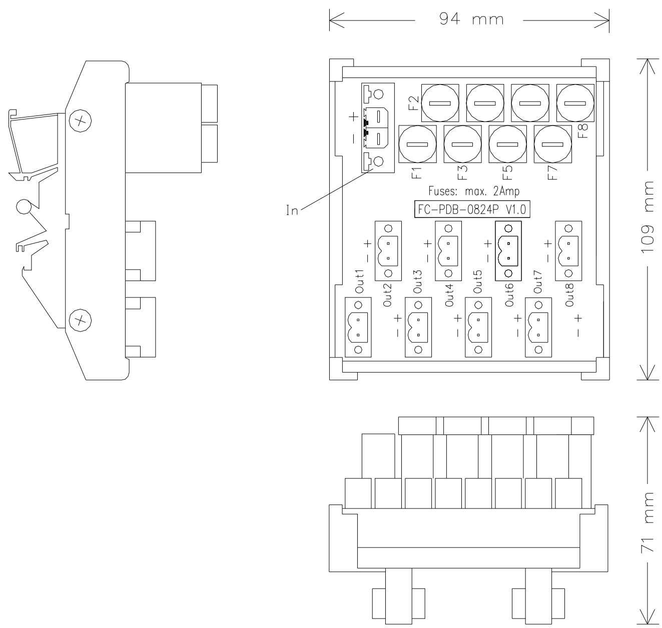
Power Distribution Board (24Vdc, 2 Amp, 8 channel)

Description

The PDB-0824P power distribution board enables easy distribution of 24Vdc from the main power rail to individual 24Vdc devices inside the cabinet enclosure, such as fan units and FTAs.

Figure 500 on page 796 shows the PDB-0824P board with one 24Vdc entry connector (In) for connection to the main bus bar and eight (2 Amp fused) 24Vdc field connectors (Out1 thru Out8) for connection to eight 24Vdc devices.

Figure 500 PDB-0824P board layout



A 24 Vdc power distribution cable (see data sheet "PDC-MB24-y" on page 814 for details) can be used to connect the main power bar to In.

- When using other connection cables make sure the wire size is adequate and a Weidmuller BVZ 7.62HP/02F SN connector with two keying pins is used to connect to In of the PDB-0824P (see "Pin allocation" on page 797).

24V distribution cables (see “PDC-FTA24” on page 816) connect the PDB-0824P with up to eight 24Vdc devices.

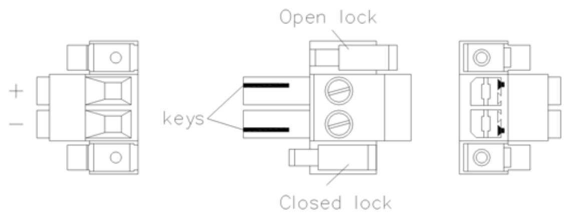
- When using other connection cables make sure the wire size is adequate and a Weidmuller BLZ 5.08/2F SN SW or equivalent connector (e.g. BL 5.08/2 SN OR) is used to connect to one of the Outx connectors of the PDB-0824P (see “Pin allocation” on page 797).

Pin allocation

Figure 501 on page 797 shows the top, side & bottom view and the pin assignment of the Weidmuller BVZ 7.62HP/02F SN cable-connector on In.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the main bus bar

Figure 501 Power connector on In (Weidmuller BVZ 7.62HP/02F SN) top, side and bottom view

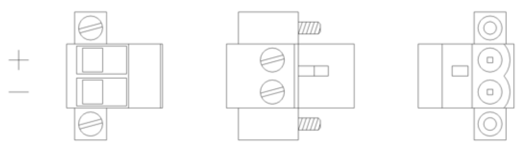


The two (red) locking slides of the cable-connector in Figure 501 on page 797 keep the cable-connector locked when inserted into In.

Figure 502 on page 797 shows the top, side & bottom view and the pin assignment of the Weidmuller BLZ 5.08/2F SN SW.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the consumer
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the consumer

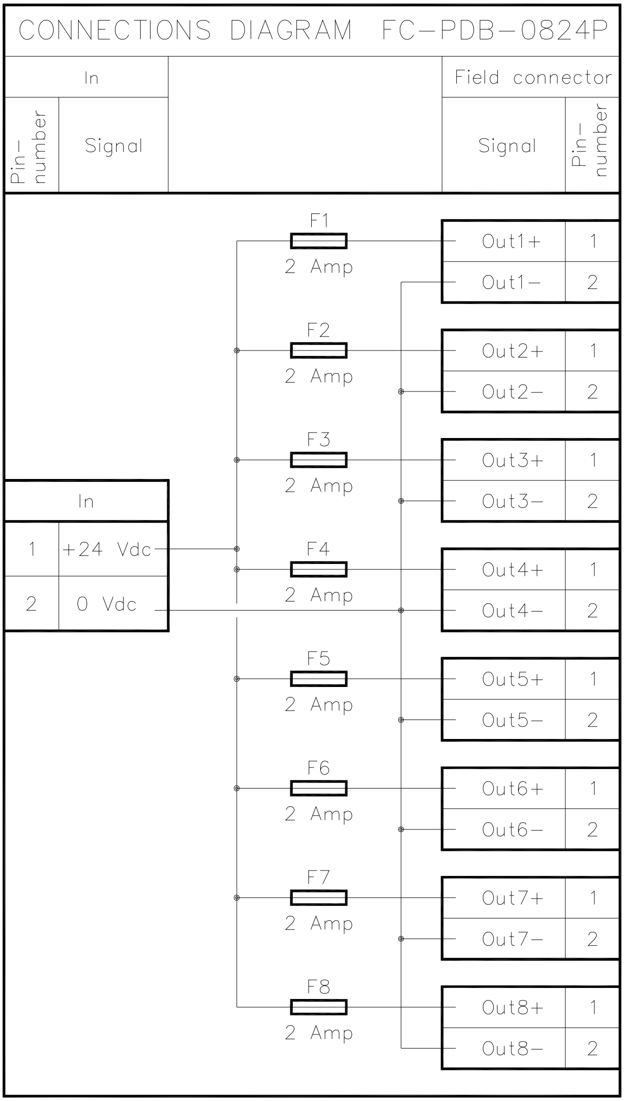
Figure 502 Power connector on Outx (Weidmuller BLZ 5.08/2F SN SW) top, side and bottom view



Connections

The connection diagram of the PDB-0824P module:

Figure 503 Connection diagram



Technical data

General	Type number[1] :	FC-PDB-0824P V1.0
	Approvals:	CE; UL, TUV, CSA pending
Fuses	rating	max. 2 AT (slow acting)
	dimensions:	5 x 20 mm (0.20 x 0.79 in)
Connectors	In make and type:	2 pole header with keying • Weidmuller: BVZ 7.62HP/02F SN (conn.) • Weidmuller: BV/SV7.62HP KO (keys)
	Field connector make and type:	2 pole socket block Weidmuller: BLZ 5.08/2F SN SW
Physical	Module dimensions:	94 x 109 x 71 mm (L x W x H) 3.7 x 4.3 x 2.8 in (L x W x H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	95 mm (3.74 in)

1 FC-type modules are conformal coated modules.

PDC-MBMB-1

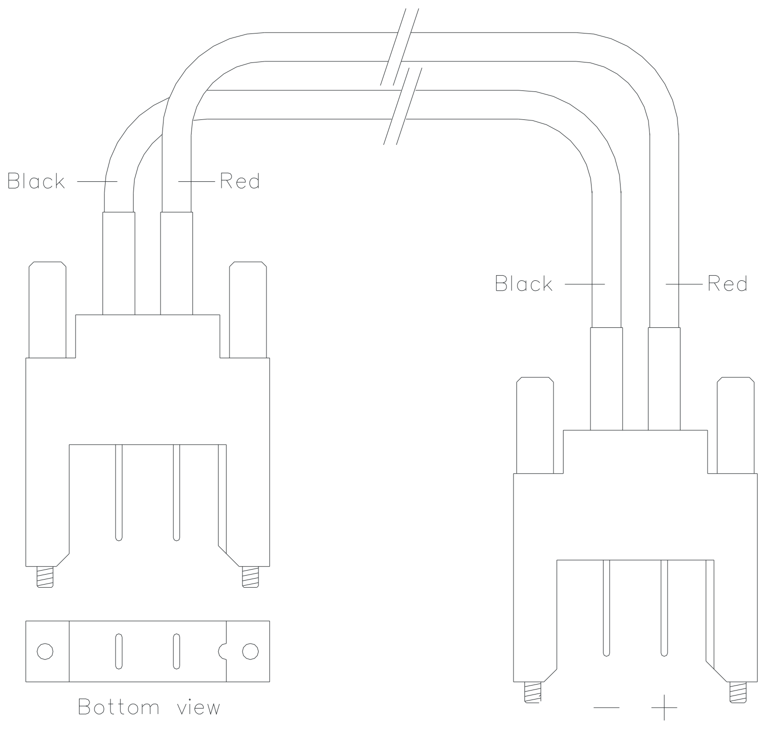
Mains power distribution cable (24Vdc, 48Vdc)

Description

The PDC-MBMB-1 power distribution cable transfers the 24Vdc or 48Vdc from one mains power rail of type FS-MB-0001 to another mains power rail of that type.

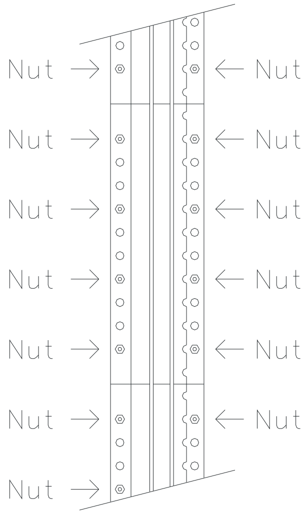
Figure 504 on page 800 shows the layout of the PDC-MBMB-1 power distribution cable.

Figure 504 Layout of PDC-MBMB-1 power distribution cable



The cable plugs in the mains power rail with a polarized connector that must be locked on the rail using its two screws. To enable this, the plug must be placed on one of the rail positions that has nuts in the rail housing (see Figure 505 on page 801).

Figure 505 Section of the MB-0001 mains power rail



High loads

With second rail loads exceeding 30 Amp (up to 100 Amp) it is recommended to use two PDC-MBMB-1 cables to connect the two power rails.

- Connect the first cable close to the top of each power rail.
- Connect the second cable close to the bottom of each power rail.

Technical data

General	Type number:	FS-PDC-MBMB-1
	Approvals:	UL, CSA; FM pending
Cables	Type:	HV8-55-c (AWG 8)
	Length:	3 meter
Connectors	2-pole Jackscrew	
	Type connector:	D-TAB-200-JCK
	Type pin:	D-TAB-200-8-S
	Power rating:	55 A
	Temperature:	max. 125 ºC (257 ºF)

PDC-CPSET

Power distribution cable set Control Processor (24Vdc)

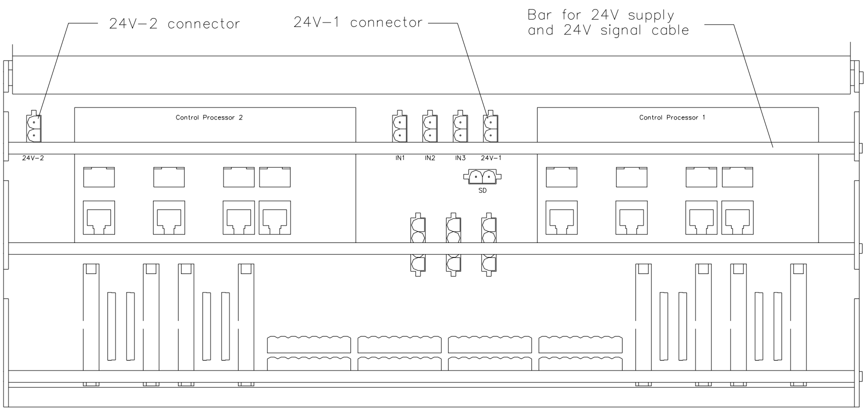
Description

The FS-PDC-CPSET power distribution cable-set transfers power from the 24 Vdc mains bus bar type FS-MB-0001 to the Controller chassis.

The set consists of 2 power cables, one for each Control Processor.

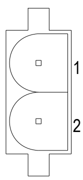
The cables are placed on the appropriate connectors on the backplane (24V-1 and 24V-2 see Figure 506 on page 802).

Figure 506 Position of 24 V connectors on the SM Controller backplane



Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:

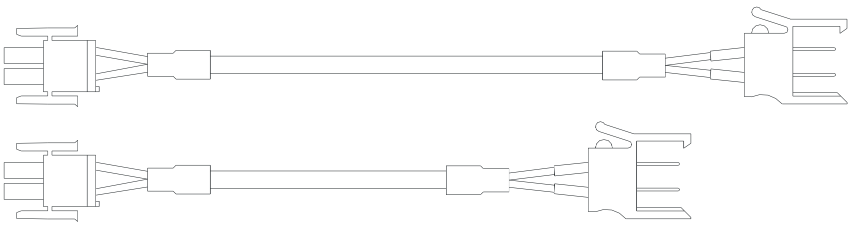
		24V-1	**24V-2**
	1	+24V for CP1	+24V for CP2
	2	0V for CP1	0V for CP2

Layout

Figure 507 on page 803 shows the layout of the FS-PDC-CPSET power distribution cable set.

- The FS-PDC-CP24-1 (the short cable in Figure 507 on page 803) connects CP1 with the 24V supply. This cable is placed between the 24V-1 connector on the SM Controller backplane and the 24 Vdc mains bus bar, type FS-MB-0001.
- The FS-PDC-CP24-2 (the long cable in Figure 507 on page 803) connects CP2 with the 24V supply. This cable is placed between the 24V-2 connector on the SM Controller backplane and the 24 Vdc mains bus bar, type FS-MB-0001.

Figure 507 Layout of the FS-PDC-CPSET power distribution cables



Technical data

General	Type number:	FS-PDC-CPSET
	Approvals:	UL, CSA; FM pending
Cable	Type:	CC600 2 x 2.5 mm^2
	Length FS-PDC-CP24-1:	54 cm (21.26 in)
	Length FS-PDC-CP24-2:	77 cm (30.31 in)
Connectors	Bus bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	SM Controller side:	2 pole mate-n-lock

PDC-IOSET

Power distribution cable set IO chassis (24Vdc, 48Vdc or 110Vdc)

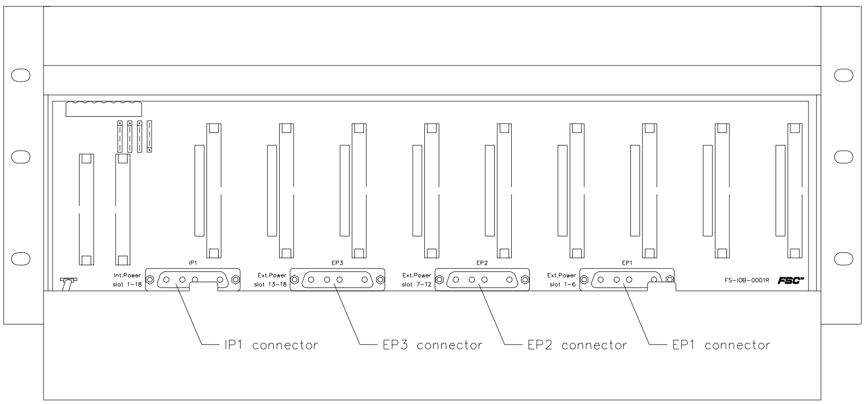
Description

The FS-PDC-IOSET power distribution cables of the IO chassis transfer 24 Vdc, 48 Vdc or 110Vdc from mains power rails of type FS-MB-0001 to the IO chassis. Figure 508 on page 804 shows the position of the IP1, EP1, EP2, and EP3 connector on the back of an IO chassis.

Attention:

To avoid assembly mistakes the use of color coded labels and/or sleeves is recommended on both the cable sets and the connectors when applied for voltages other than 24Vdc.

Figure 508 Position of the power connectors on an IO backplane



The following module slots are powered by the IO chassis power distribution cables:

IO module slots	Power supply voltage	Cable
1-6	External	FS-PDC-IOEP1a
7-12	External	FS-PDC-IOEP2a
13-18	External	FS-PDC-IOEP3a
All	Internal	FS-PDC-IOIP1a

Pin allocation

The pin allocation of the external power connectors EP1, EP2 and EP3 of a redundant IO chassis are:

Pin	Marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The pin allocation of the internal power connector IP1 of a redundant IO chassis is:

Pin	Marking	IP1	To slot
1	Red (1)	IP	1, 3, 5, 7, 9, 11, 13, 15 and 17
3	Black (1)	0 Volt	
4	Black (2)	0 Volt	
5	Red (2)	IP	2, 4, 6, 8, 10, 12, 14, 16 and 18

The pin allocation of the External Power connectors EP1, EP2 and EP3 of a non-redundant IO chassis are:

Pin	marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

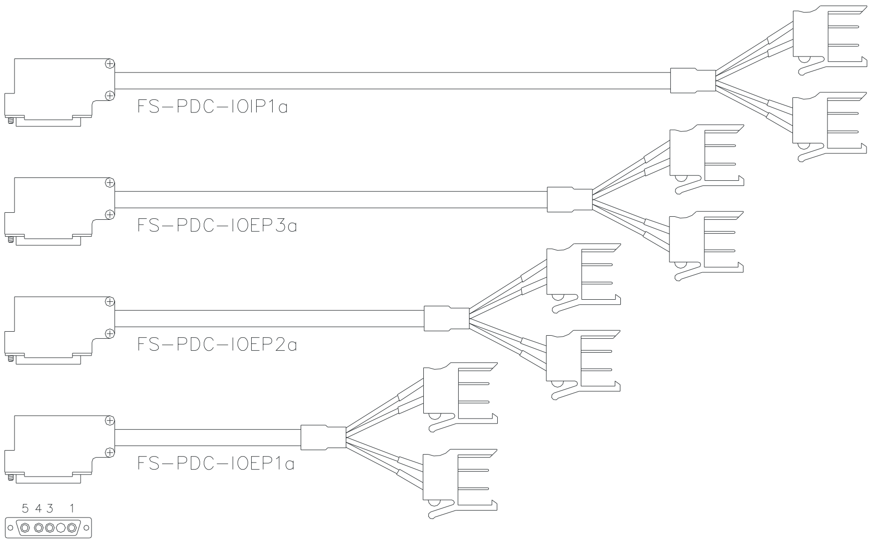
The pin allocation of the Internal Power connector IP1 in a non-redundant IO chassis is:

Pin	Marking	IP1
1	Red (1)	IP slot 1-9
3	Black (1)	0 Volt
4	Black (2)	0 Volt
5	Red (2)	IP slot 10-18

Layout

Figure 509 on page 806 shows the layout of the FS-PDC-IOSET power distribution cables.

Figure 509 Layout of the FS-PDC-IOSET power distribution cables



Technical data

General	Type number:	FS-PDC-IOSET
	Approvals:	UL, CSA; FM pending
Cable	Type:	CC 600 World 4 × 2.5 mm^2
	Length:	33 cm (FS-PDC-IOEP1a) 41 cm (FS-PDC-IOEP2a) 49 cm (FS-PDC-IOEP3a) 57 cm (FS-PDC-IOIP1a)
Connectors	Bus bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	IO chassis side:	FM5W5 S (female) housing: low profile, 90°

PDC-CP24

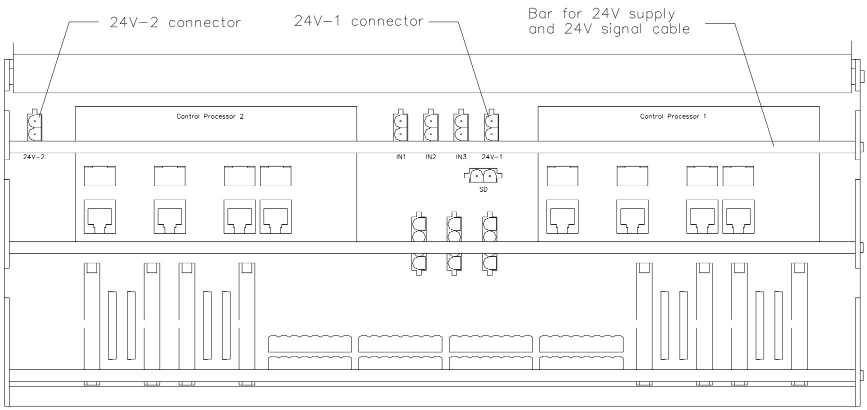
Power distribution cable Control Processor (24Vdc)

Description

The FS-PDC-CP24 power distribution cable of the Control Processor transfers the 24 Vdc from the mains power rails to Controller chassis. Each Control Processor has a separate FS-PDC-CP24 cable.

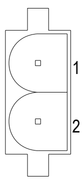
The cables are placed on the appropriate connectors on the backplane (24V-1 and 24V-2 see Figure 510 on page 807).

Figure 510 Position of 24 V connectors on the SM Controller backplane



Pin allocation

The back view and pin allocation of the 24V-1 and 24V-2 connectors are:

		**24V-1**	**24V-2**
	1	+24V for CP1	+24V for CP2
	2	0V for CP1	0V for CP2

Layout

Figure 511 on page 808 shows the layout of the FS-PDC-CP24 power distribution cable.

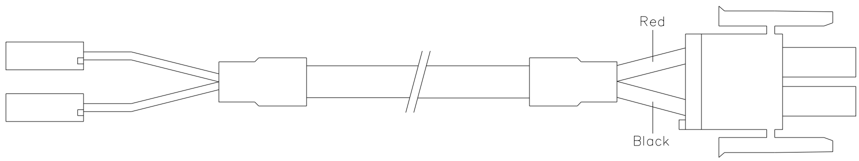


Figure 511 Layout of the FS-PDC-CP24 power distribution cable

Technical data

General	Type number:	FS-PDC-CP24
	Approvals:	UL, CSA, FM
Cable	Type:	Alphawire 1899AWG/2C (2×1.3 mm^2)
	Length:	1 m
Connectors	Bus bar side:	Fast-on
	SM Controller side:	2 pole mate-n-lock

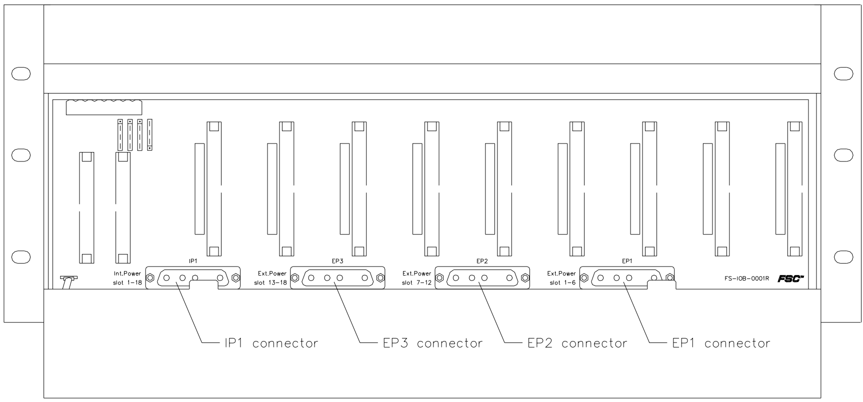
PDC-IOxPx

Power distribution cable IO chassis (24Vdc, 48Vdc or 110Vdc)

Description

The FS-PDC-IOxPx power distribution cables of the IO chassis transfer 24 Vdc, 48 Vdc or 110 Vdc from the mains power rails to the IO chassis. Figure 512 on page 809 shows the position of the IP1, EP1, EP2, and EP3 connector on the back of an IO chassis.

Figure 512 Position of the power connectors on an IO backplane



The following module slots are powered by the IO chassis power distribution cables:

IO module slots	Power supply voltage	Cable
1-6	External	FS-PDC-IOEP1
7-12	External	FS-PDC-IOEP2
13-18	External	FS-PDC-IOEP3
All	Internal	FS-PDC-IOIP1

Pin allocation

The pin allocation of the external power connectors EP1, EP2 and EP3 of a redundant IO chassis are:

Pin	Marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 15, 17	EP slot 7, 9, 11	EP slot 1, 3, 5
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 14, 16, 18	EP slot 8, 10, 12	EP slot 2, 4, 6

The pin allocation of the internal power connector IP1 of a redundant IO chassis is:

Pin	Marking	IP1	To slot
1	Red (1)	IP	1, 3, 5, 7, 9, 11, 13, 15 and 17
3	Black (1)	0 Volt	
4	Black (2)	0 Volt	
5	Red (2)	IP	2, 4, 6, 8, 10, 12, 14, 16 and 18

The pin allocation of the External Power connectors EP1, EP2 and EP3 of a non-redundant IO chassis are:

Pin	marking	EP3	EP2	EP1
1	Red (1)	EP slot 13, 14, 15	EP slot 7, 8, 9	EP slot 1, 2, 3
3	Black (1)	0 Volt	0 Volt	0 Volt
4	Black (2)	0 Volt	0 Volt	0 Volt
5	Red (2)	EP slot 16, 17, 18	EP slot 10, 11, 12	EP slot 4, 5, 6

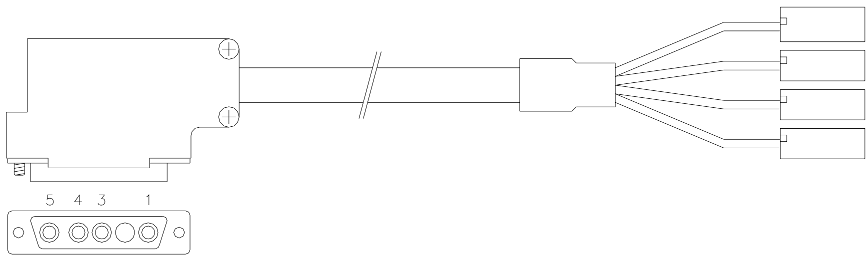
The pin allocation of the Internal Power connector IP1 in a non-redundant IO chassis is:

Pin	Marking	IP1
1	Red (1)	IP slot 1-9
3	Black (1)	0 Volt
4	Black (2)	0 Volt
5	Red (2)	IP slot 10-18

Layout

Figure 513 on page 811 shows the layout of the FS-PDC-IOxPx power distribution cable.

Figure 513 Layout of the FS-PDC-IOxPx power distribution cables



Technical data

General	Type number:	FS-PDC-IOEP1 FS-PDC-IOEP2 FS-PDC-IOEP3 FS-PDC-IOIP1
	Approvals:	UL, CSA, FM
Cable	Type:	CC 600 World 4 × 2.5 mm^2
	Length:	64 cm (IOEP1) 72 cm (IOEP2) 80 cm (IOEP3) 88 cm (IOIP1)
Connectors	Bus bar side:	Fast-on
	IO chassis side:	FM5W5 S (female) housing: low profile, 90°

PDC-MB24-x

Power Distribution Cable (24Vdc)

Description

The FS-PDC-MB24-x power distribution cables transfer the 24Vdc from the main power rail of type FS-MB-0001 to:

- power distribution boards like the FC-PDB-0824 (for details see “PDB-0824” on page 792),
- FTAs equipped with a Weidmuller BVZ 7.62/02F SW power connector, keyed for 24Vdc.

Table 86 on page 812 provides a listing of available cable types and associated lengths.

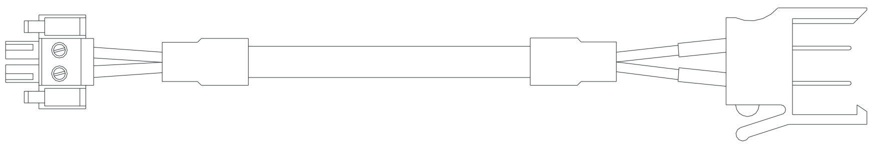
Table 86 Type and length of FS-PDC-MB24-x power distribution cables

Cable type	length
FS-PDC-MB24-1	145 cm (57.1 in)
FS-PDC-MB24-2	245 cm (96.5 in)
FS-PDC-MB24-3	325 cm (128.0 in)

Layout

Figure 514 on page 812 shows the layout of the FS-PDC-MB24-x power distribution cable.

Figure 514 Layout of the FS-PDC-MB24-x power distribution cable



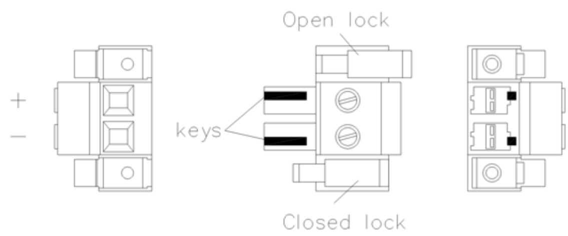
FTA / board connector with 24 Vdc keying

A Weidmuller BVZ 7.62/02F SW cable-connector with 24Vdc keying is used to connect the cable to an FTA or a 24Vdc power distribution board.

Figure 515 on page 813 shows the views, keying and the pin assignment of the Weidmuller BVZ 7.62/02F SW cable-connector.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the main bus bar

Figure 515 FTA/board side connector (Weidmuller BVZ 7.62/02F SW) views and 24 Vdc keying



Two (orange) locking slides of the cable-connector in Figure 515 on page 813 keep the cable-connector locked when inserted into the FTA or the power distribution board.

Technical data

General	Type numbers:	FS-PDC-MB24-1 FS-PDC-MB24-2 FS-PDC-MB24-3
	Approvals:	UL, CSA; FM pending
Cable	Type:	CC600 2 x 6mm^2
	Length FS-PDC-MB24-1:	145 cm (57.1 in)
	Length FS-PDC-MB24-2:	245 cm (96.5 in)
	Length FS-PDC-MB24-3:	325 cm (128.0 in)
Connectors	mains power bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	FTA / board side:	2 pole header with keying Weidmuller: BVZ 7.62/02F SW
	FTA / board keying	Weidmuller: KO BV/SV7.62

PDC-MB24-y

Power Distribution Cable (24Vdc)

Description

The FS-PDC-MB24-y (where “y” stands for 1P, 2P or 3P) power distribution cables transfer the 24Vdc from the main power rail of type FS-MB-0001 to:

- power distribution boards like the FC-PDB-0824P (for details see “PDB-0824P” on page 796),
- FTAs equipped with a Weidmuller SV 7.62HP/02/180F power connector, keyed for 24Vdc.

Table 87 on page 814 provides a listing of available cable types and associated lengths.

Table 87 Type and length of FS-PDC-MB24-y power distribution cables

Cable type	length
FS-PDC-MB24-1P	145 cm (57.1 in)
FS-PDC-MB24-2P	245 cm (96.5 in)
FS-PDC-MB24-3P	325 cm (128.0 in)

Layout

Figure 516 on page 814 shows the layout of the FS-PDC-MB24-y power distribution cable.

Figure 516 Layout of the FS-PDC-MB24-y power distribution cable

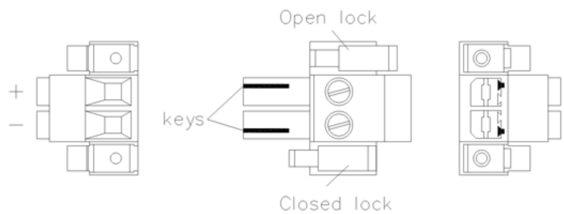
FTA / board connector with 24 Vdc keying

A Weidmuller BVZ 7.62HP/02F SN cable-connector with 24Vdc keying is used to connect the cable to an FTA or a 24Vdc power distribution board.

Figure 517 on page 815 shows the views, keying and the pin assignment of the Weidmuller BVZ 7.62HP/02F SN cable-connector.

1. The pin marked “+” is pin 1; connect to +24Vdc wire to the main bus bar
2. The pin marked “-” is pin 2; connect to 0Vdc wire to the main bus bar

Figure 517 FTA/board side connector (Weidmuller BVZ 7.62HP/02F SN) views and 24 Vdc keying



Two (red) locking slides of the cable-connector in Figure 517 on page 815 keep the cable-connector locked when inserted into the FTA or the power distribution board.

Technical data

General	Type numbers:	FS-PDC-MB24-1P FS-PDC-MB24-2P FS-PDC-MB24-3P
	Approvals:	UL, CSA and FM pending
Cable	Type:	CC600 2 x 6mm^2
	Length FS-PDC-MB24-1P:	145 cm (57.1 in)
	Length FS-PDC-MB24-2P	245 cm (96.5 in)
	Length FS-PDC-MB24-3P:	325 cm (128.0 in)
Connectors	mains power bar side:	2 pole Squeeze To Release type: D-TAB-200-STR
	FTA / board side:	2 pole header with keying Weidmuller: BVZ 7.62HP/02F SN
	FTA / board keying	Weidmuller: BV/SV7.62HP KO

PDC-FTA24

Power Distribution Cable (24Vdc)

Description

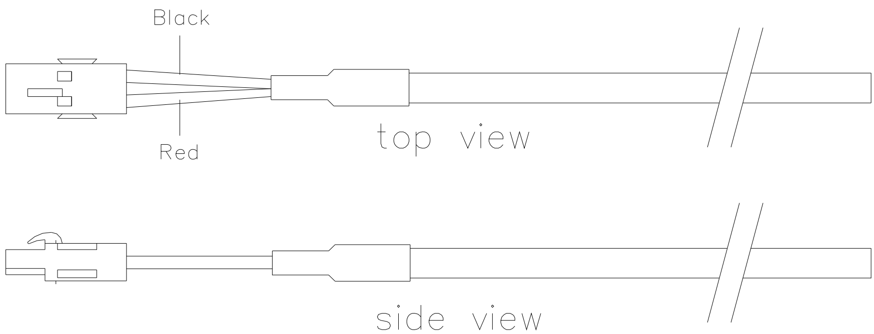
The FS-PDC-FTA24 power distribution cables transfer the 24Vdc from the FC-PDB-0824 power distribution board to individual 24Vdc devices inside the cabinet enclosure, such as fan units and FTAs.

(For details on the FC-PDB-0824 power distribution board see “PDB-0824” on page 792.)

The FS-PDC-FTA24 is equipped with a connector on the FC-PDB-0824 side, and no connector on the device side.

Figure 518 on page 816 shows the layout of the FS-PDC-FTA24 power distribution cable.

Figure 518 Layout of the FS-PDC-FTA24 power distribution cable



Before connecting the FS-PDC-FTA24 to the device, its wires must be cut to the required length and fitted with a suitable connector for the device. In Figure 518 on page 816:

- The red wire represents the +24Vdc.
- The black wire represents the 0Vdc.

Technical data

General	Type numbers:	FS-PDC-FTA24
	Approvals:	UL, CSA; FM pending
Cable	Type:	2 x 1.31 mm^2 (AWG 16) tri-rated
	Length:	2 m (78.74 in)
Connector	housing type:	2 pole socket block Weidmuller BLC 5.08/2BR OR
	crimp pin type:	Weidmuller DFFC 1.5-2.5 SN E

5 Volt and watchdog distribution

19

This chapter describes the 5 Volt and Watchdog distribution boards and cables.

5 Volt and Watchdog distribution layout

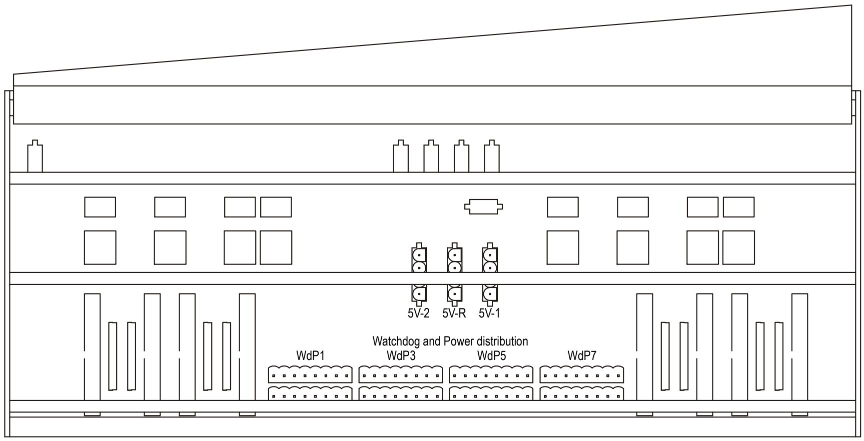
This sub-section contains these topics:

5 Volt and Watchdog distribution layout (Safety Manager)

The 5V supply voltages and watchdog signals of Safety Manager are generated in the Controller chassis (see “CPCHAS-0001” on page 87). These signals are available on the backplane of the Controller chassis.

Figure 519 on page 821 shows a -simplified- view of the Controller backplane.

Figure 519 Position of the 5V and Wd connectors on a Controller backplane



Attention

The connectors that are used on the cables for Watchdog and 5V distribution can be sensitive to mechanical tension. These cables are connected to WdP1 thru WdP8 on the CP backplane and WdP on IO backplanes. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

The eight WdPx connectors (two rows of four connectors) at the bottom middle of Figure 519 on page 821 are used to transfer watchdog and power (5V) to the IO-chassis in the controller cabinet.

The three 5V-x connectors (5V-2, 5V-R and 5V-1) in the center of Figure 519 on page 821 are used to transfer watchdog and 5V to the IO chassis in the extension cabinet(s).

Figure 520 on page 822 shows the watchdog and power (5V) connector on a -simplified- non-redundant IO backplane.

Figure 520 Position of the WdP connector on a non-redundant IO chassis

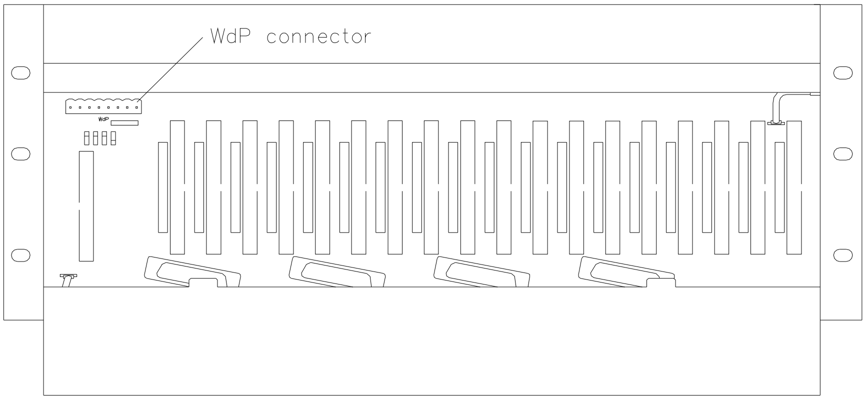


Figure 521 on page 822 shows the watchdog and power (5V) connector on a -simplified- redundant IO backplane.

Figure 521 Position of the WdP connector on a redundant IO chassis

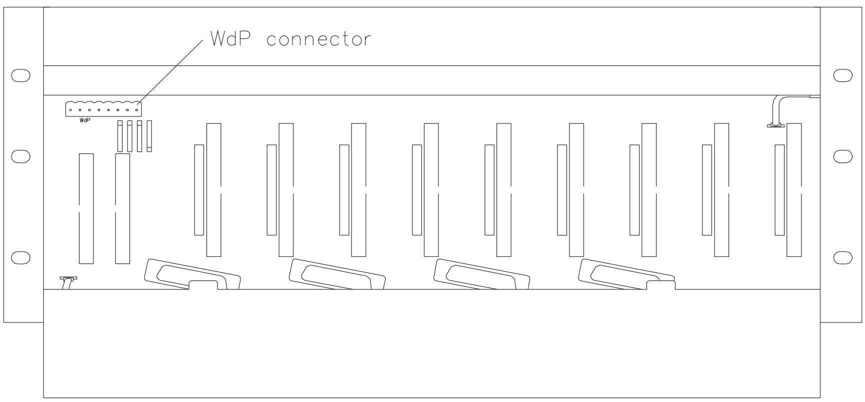


Figure 522 on page 823 shows the watchdog and 5V distribution inside a controller cabinet (left) and inside an IO extension cabinet (right).

In a controller cabinet, all cables come from the CP chassis backplane. In an IO extension cabinet, all cables come from an PDB-IOX05 board (see "PDB-IOX05" on page 830).

The used cable depends on the IO chassis type that is connected:

- Non-redundant IO chassis require the PDC-IOS05 cable (see "PDC-IOS05" on page 838).

- Redundant IO chassis require the PDC-IOR05 cable (see “PDC-IOR05” on page 840).

Figure 522 5V and Wd distribution wiring in a controller cabinet resp. extension cabinet

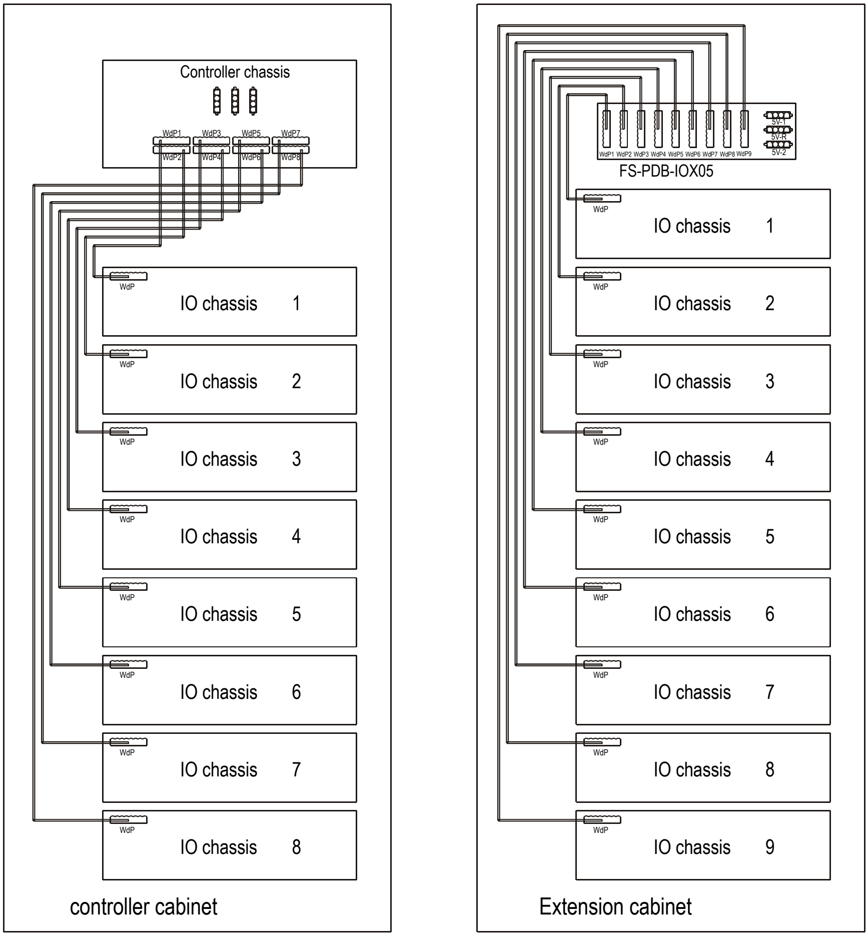


Figure 523 on page 824 shows the 5V and watchdog distribution between the controller cabinet and a single IO extension cabinet.

All (three) cables to the IO extension cabinet are of the type PDC-IOX05-1 (see “PDC-IOX05-x” on page 842).

The cable on connector ‘5V-1’ carries 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector ‘5V-2’ carries 0V (ground), the watchdog of CP2 and the 5V of CP2.

The cable on connector ‘5V-R’ carries 0V (ground), the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 155 on page 250) and the (redundant) 5V of CP1 and CP2 (see Figure 47 on page 92).

IO extension cabinets containing only redundant IO use the signals on the ‘5V-1’ and ‘5V-2’ cables.

IO extension cabinets containing only non-redundant IO only use the signals on the ‘5V-R’ cable.

Figure 523 5V and Wd distribution between the controller cabinet and a single IO extension cabinet

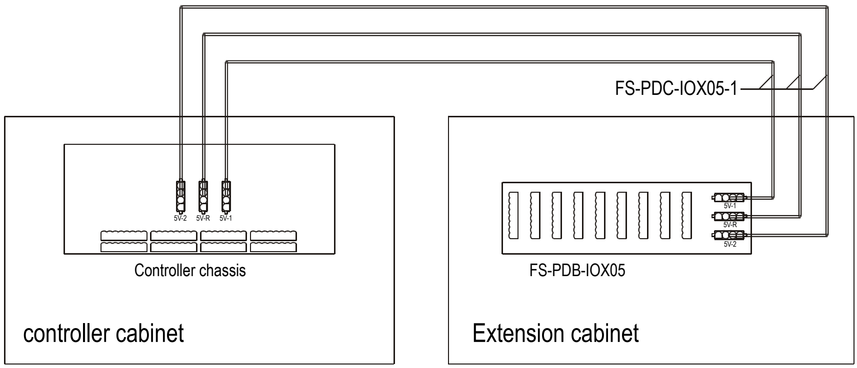
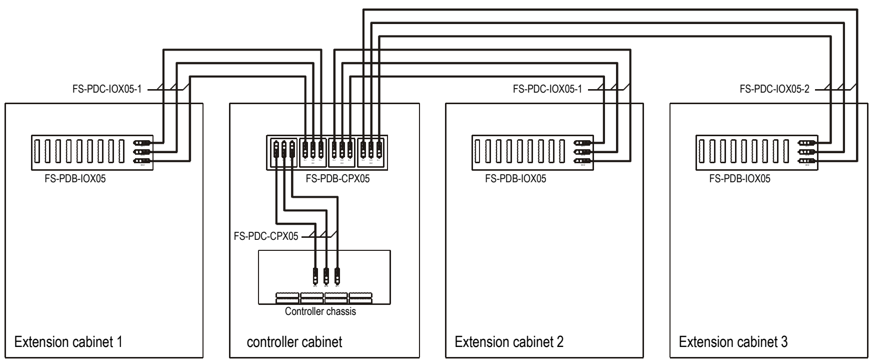


Figure 524 on page 824 shows the 5V and watchdog distribution between the controller cabinet and more than one IO extension cabinet.

All cables to the IO extension cabinet are of type PDC-IOX05-1 (short) or type PDC-IOX05-2 (long) (see “PDC-IOX05-x” on page 842). These cables go to an PDB-CPX05 board (see “PDB-CPX05” on page 833) in the controller cabinet.

The PDB-CPX05 board itself is linked to the CP backplane using three PDC-CPX05 cables (see “PDC-CPX05” on page 844).

Figure 524 5V and Wd distribution between the controller cabinet and three IO extension cabinets

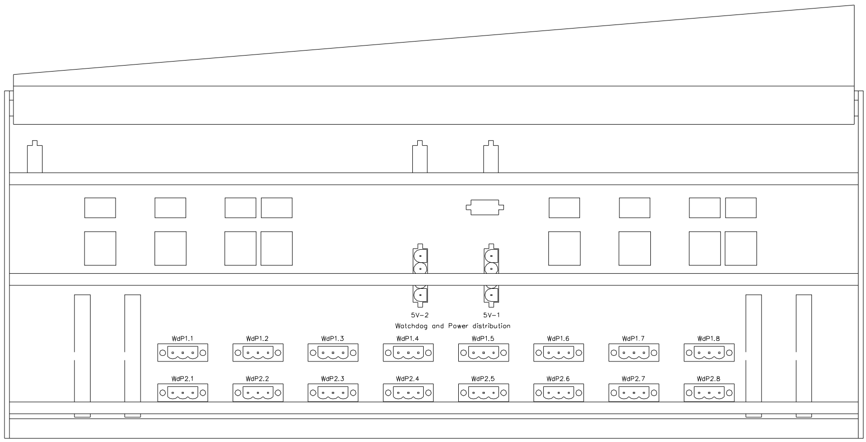


5 Volt and Watchdog distribution layout (Safety Manager A.R.T.)

The 5V supply voltages and watchdog signals of Safety Manager are generated in the Control Processor chassis (see “CPCHAS-0002” on page 116). These signals are available on the rear side of the Control Processor chassis.

Figure 525 on page 825 shows a -simplified- view of the rear side of the Controller chassis.

Figure 525 Position of the 5V and Wd connectors on the rear side of a Controller chassis



The sixteen WdPx.y connectors (two rows of eight) at the bottom middle of Figure 525 on page 825 are used to transfer WatchDog and Power (5 Volt) to the IO-chassis in the controller cabinet of non-UL cabinets.

- The WdP1.y connectors carry the 5V and WD of CP1.
- The WdP2.y connectors carry the 5V and WD of CP2.

The two 5V-x connectors (5V-2 and 5V-1) in the centre of Figure 525 on page 825 are used to transfer WatchDog and 5 Volt to the IO-chassis in an extension cabinet and for all IO-chassis in UL cabinets.

Figure 526 on page 826 shows the WatchDog and Power (5 Volt) connectors on the back of a -simplified- non-redundant IO chassis.

Figure 526 Position of the WdP connector on a non-redundant IO chassis

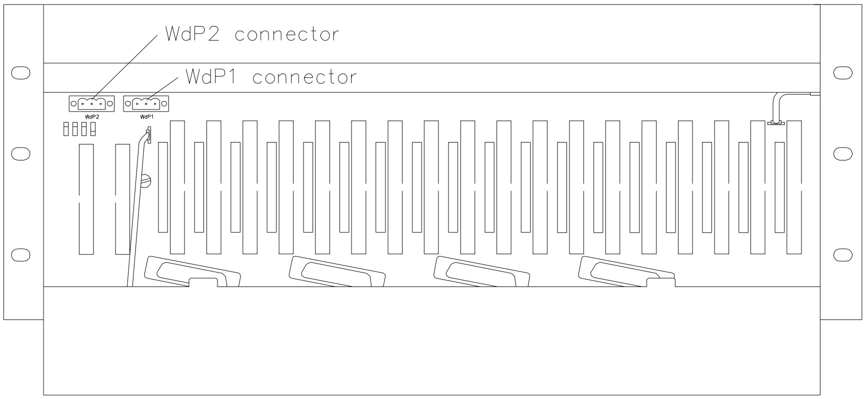


Figure 527 on page 826 shows the WatchDog and Power (5 Volt) connectors on the back of a -simplified- redundant IO chassis.

Figure 527 Position of the WdP connector on a redundant IO chassis

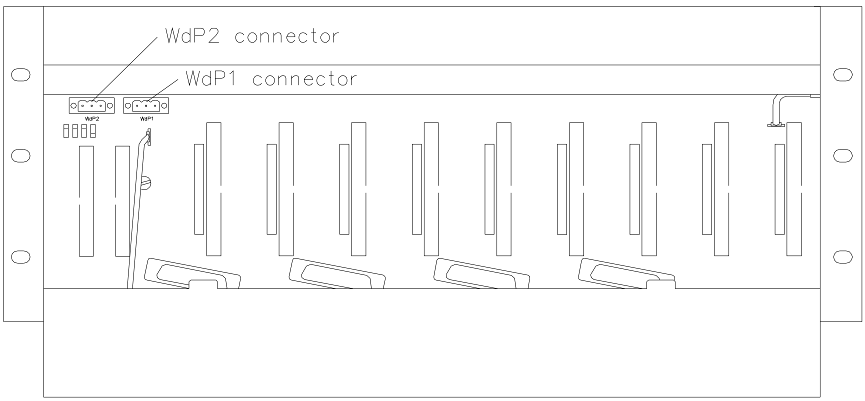


Figure 528 on page 827 shows the WatchDog and 5 Volt distribution inside a controller cabinet (left) and inside an IO extension cabinet (right) for non-UL applications.

Each chassis requires one pair of cables type FS-PDC-ART05 (see "PDC-ART05" on page 846).
In the controller cabinet, all cables come from the CP chassis backplane.
In the IO extension cabinet, all cables come from an FC-PDB-ARTF05 board (see "PDB-ARTF05" on page 835).
The cables between the controller cabinet and the FC-PDB-ART05 are a pair of FS-PDC-IOX05-1 cables.

Figure 528 5V and Wd distribution wiring in a controller cabinet and an extension cabinet - non-UL version

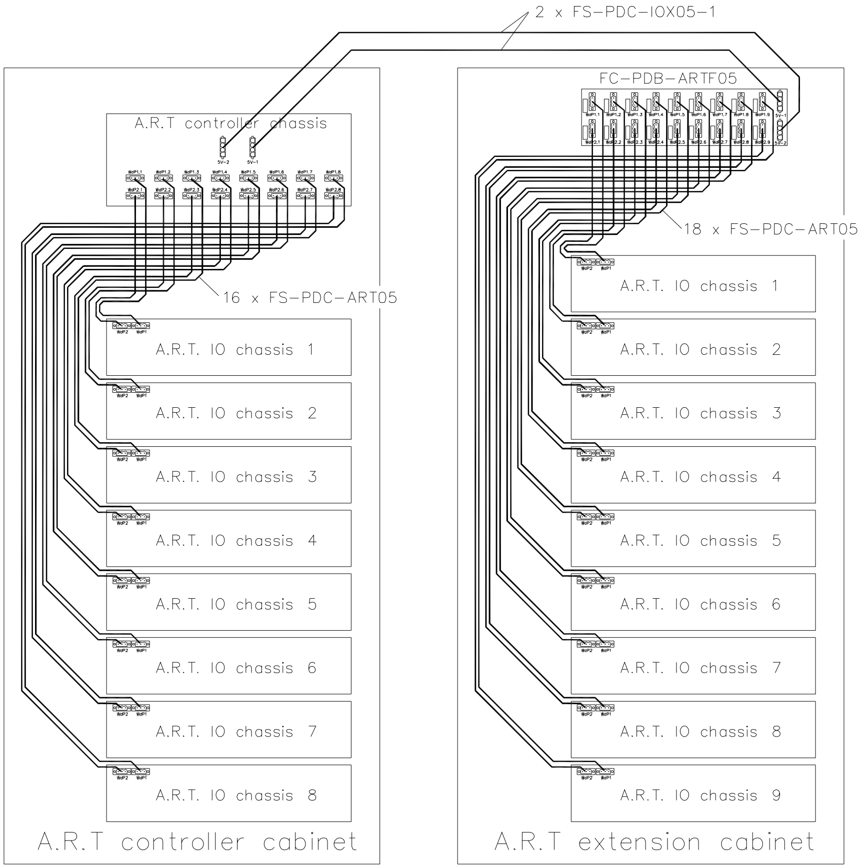


Figure 529 on page 828 shows the 5 Volt and watchdog distribution in the controller cabinet for UL applications.

UL requires the use of fused 5 Volt distribution that is accomplished *on* the FC-PDB-ARTF05 module.
The FC-PDB-ARTF05 gets its power from the Controller chassis with a pair of FS-PDC-CPX05 cables (see “PDC-CPX05” on page 844).
All IO chassis are connected with the FS-PDB-ARTF05.

Each chassis requires one pair of cables type FS-PDC-ART05 (see “PDC-ART05” on page 846).

Figure 529 5V and Wd distribution wiring in a controller cabinet - UL version

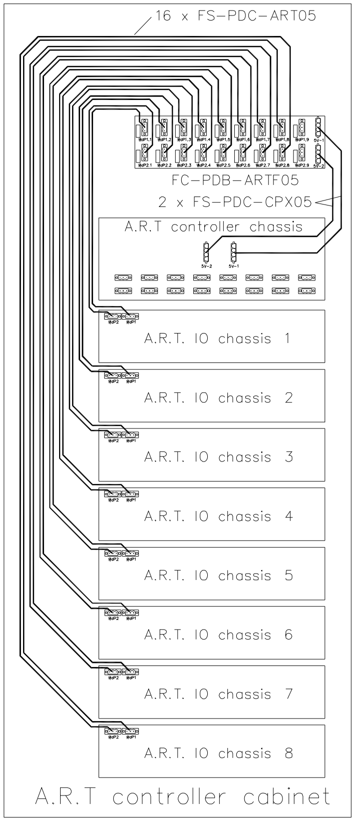
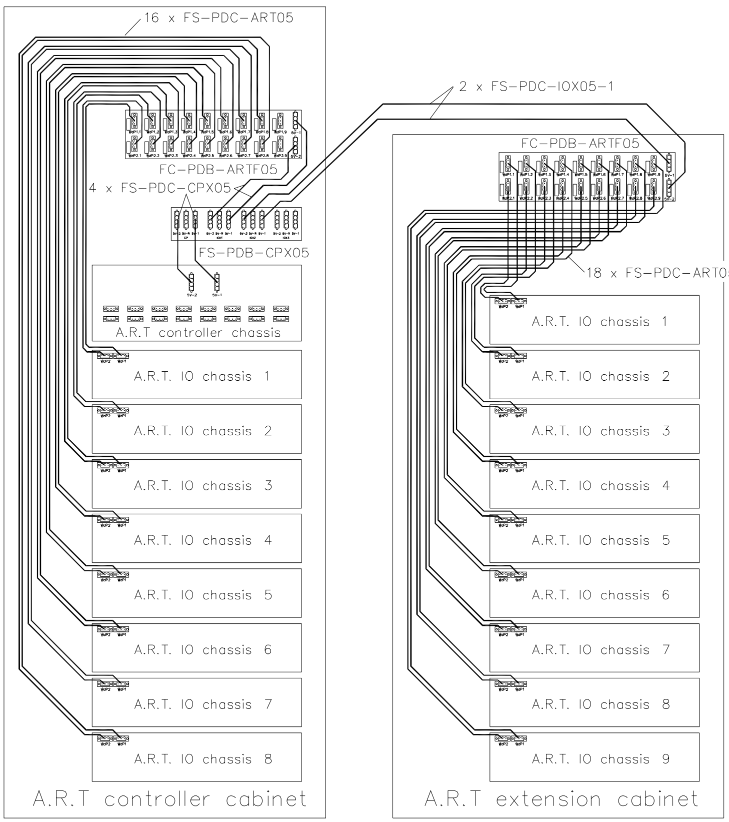


Figure 529 on page 828 shows the 5 Volt and watchdog distribution in a Controller cabinet with Extension cabinet for UL applications.

UL requires the use of fused 5 Volt distribution that is accompleshed *on* the FC-PDB-ARTF05 module.
The 5V and Watchdog signals of the controll chassis are multiplied on the FS-PDB-CPX05 module (see “PDB-CPX05” on page 833).
The local FC-PDB-ARTF05 gets its power from the FS-PDB-CPX05 using a pair of FS-PDC-CPX05 cables (see “PDC-CPX05” on page 844).
The FC-PDB-ARTF05 in the extension cabinet gets its power from the FS-PDB-CPX05 using a pair of FC-PDC-IOX05-1 cables (see “PDC-IOX05-x” on page 842).
All A.R.T. IO chassis are connected with the FS-PDB-ARTF05.

Each chassis requires one pair of cables type FS-PDC-ART05 (see “PDC-ART05” on page 846).

Figure 530 5V and Wd distribution wiring in a controller cabinet and an extension cabinet - UL version



PDB-IOX05

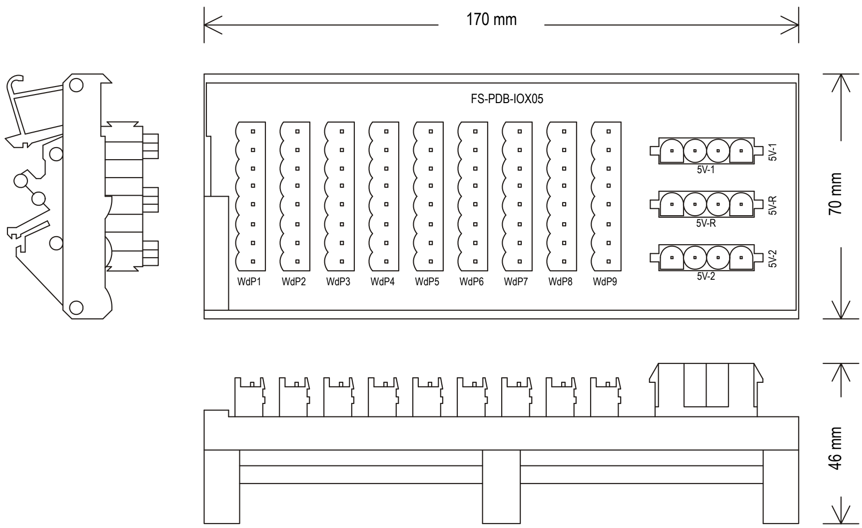
Power Distribution Board extension IO cabinet (5 Vdc, Watchdog)

Description

The PDB-IOX05 power distribution board for extension IO cabinets is a board that enables the distribution of the 5V and watchdog signals of the controller cabinet to the IO chassis in an IO extension cabinet.

Figure 531 on page 830 shows the PDB-IOX05 with its 9+3 connectors.

Figure 531 PDB-IOX05 board layout



Power distribution cables from the controller cabinet (PDC-IOX05-1 and PDC-IOX05-2, see “PDC-IOX05-x” on page 842) are placed on the three (4-pole) connectors.

The cable on connector ‘5V-1’ provides 0V (ground), the watchdog of CP1 and the 5V of CP1.

The cable on connector ‘5V-2’ provides 0V (ground), the watchdog of CP2 and the 5V of CP2.

The cable on connector ‘5V-R’ carries 0V (ground), the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 155 on page 250) and the (redundant) 5V of CP1 and CP2 (see Figure 47 on page 92).

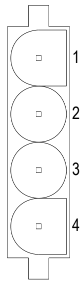
Power Distribution Cables (see “PDC-IOS05” on page 838 or “PDC-IOR05” on page 840) transfer the 5V and watchdog signal(s) to the IO chassis.

The cable on WdP1 should go to the first (highest) IO chassis.

Cables on WdP2 to WdP9 go to the next IO chassis (as far as these are available).

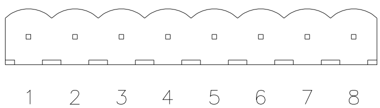
Pin allocation

The top view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:



	5V-2	**5V-R**	**5V-1**
1	ground	ground	ground
2	WD of CP2	WDR of CP1 and CP2	WD of CP1
3	ground	ground	ground
4	5V of CP2	5VR of CP1 and CP2	5V of CP1

The top view and pin allocation of the nine WdPx connectors are:



	WdPx
1	5V of CP2
2	WD of CP2
3	ground
4	5VR of CP1 and CP2
5	WDR of CP1 and CP2
6	ground
7	5V of CP1
8	WD of CP1

Technical data

General	Type numbers[1] :	FS-PDB-IOX05 FC-PDB-IOX05
	Approvals:	CE, UL, TUV, CSA
Connectors	5V-x:	4 pos, action pin, header
	WdPx:	8 pole, pin header
Physical	Module dimensions:	170 × 70 × 46 mm (L × W × H) 6.69 × 2.76 × 1.81 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	171 mm (6.73 in)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters "CC" preceding the version number.

PDB-CPX05

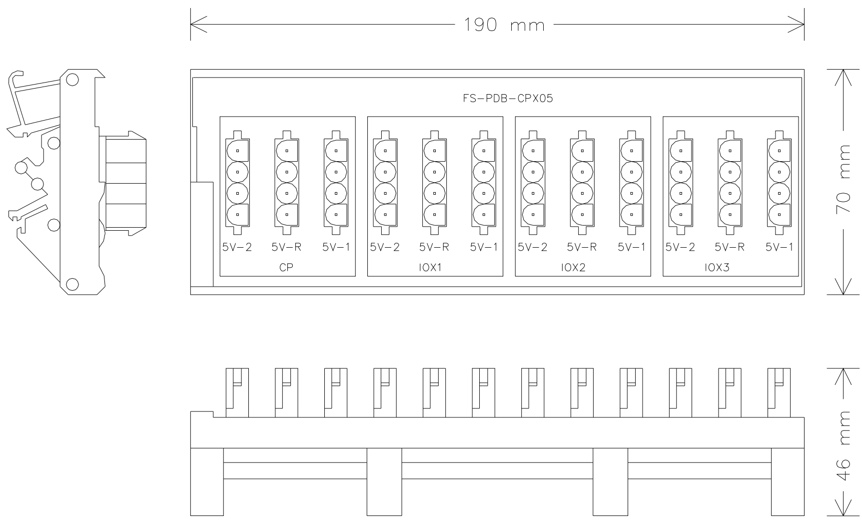
Power Distribution Board Controller cabinet (5 Vdc, Watchdog)

Description

The PDB-CPX05 power distribution board for controller cabinets is a board that enables the distribution of the 5V and watchdog signals of the Controller chassis to more than one IO extension cabinet.

Figure 532 on page 833 shows the PDB-CPX05 with its 4 × 3 connectors.

Figure 532 PDB-CPX05 board layout



Power Distribution Cables from the Controller chassis (see “PDC-CPX05” on page 844) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘CP’.

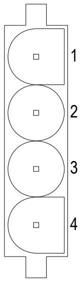
Power Distribution Cables to the first IO extension cabinet (see “PDC-IOX05-x” on page 842) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX1’.

Power Distribution Cables to the second IO extension cabinet (see “PDC-IOX05-x” on page 842) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX2’.

Power Distribution Cables to the third IO extension cabinet (see “PDC-IOX05-x” on page 842) are placed on the three connectors (‘5V-2’, ‘5V-R’ and ‘5V-1’) in section ‘IOX3’.

Pin allocation

The top view and pin allocation of the 5V-2, 5V-R and 5V-1 connectors are:

		5V-2	5V-R	5V-1
	1	ground	ground	ground
	2	WD of CP2	WDR of CP1 and CP2	WD of CP1
	3	ground	ground	ground
	4	5V of CP2	5VR of CP1 and CP2	5V of CP1

Technical data

General	Type numbers[1] :	FS-PDB-CPX05 FC-PDB-CPX05
	Approvals:	CE, UL, TUV, CSA
Connectors	Type:	4 pos, action pin, header
Physical	Module dimensions:	190 × 70 × 46 mm (L × W × H) 7.48 × 2.76 × 1.81 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	191 mm (7.52 in)

1 FS-type modules are non conformal coated modules.
FC-type modules are conformal coated modules. Conformal coated modules have the letters “CC” preceding the version number.

PDB-ARTF05

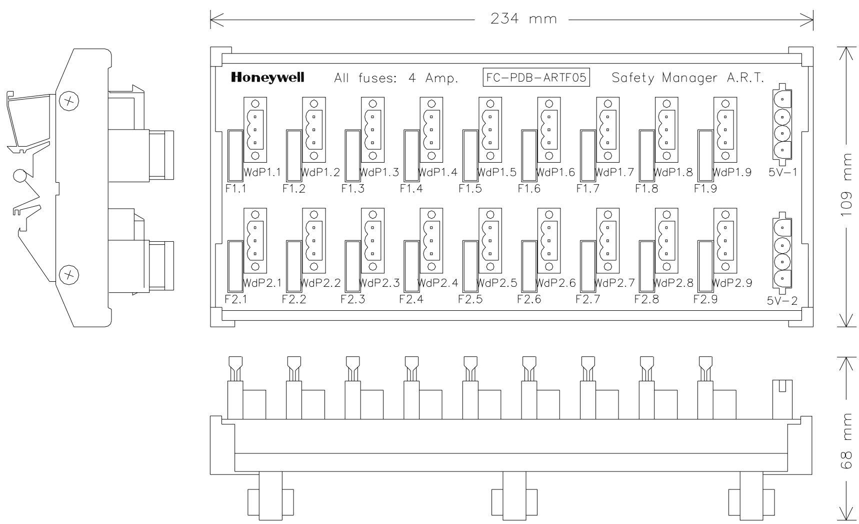
Fused Power Distribution Board for IO cabinet - 5 Vdc, Watchdog (Safety Manager A.R.T.)

Description

The PDB-ARTF05 fused power distribution board for an IO cabinet is a board that enables the distribution of the watchdog signals and fused 5V of the controller cabinet to an IO cabinet.
Fuse Fx.y transfers the incoming 5V of CPx to connector WdPx.y (e.g. fuse F2.9 transfers the incoming 5V of CP2 to connector WdP2.9).

Figure 533 on page 835 shows the PDB-ARTF05 with its 2 x 10 connectors and 2 x 9 fuses.

Figure 533 PDB-ARTF05 board layout



The PDB-ARTF05 for the Controller cabinet IO-racks is placed on top of the controller chassis.
The PDB-ARTF05 for IO-racks in the extension IO cabinet is placed in the extension IO cabinet.

Two Power Distribution Cables (type PDC-CPX05) are used to connect the Controller chassis with the PDB-ARTF05 in the controller cabinet.
Two Power Distribution Cables (type PDC-IOX05-1) are used to connect the Controller chassis with the PDB-ARTF05 in an extension IO-cabinet.

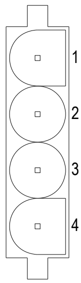
- Connect 5V-1 of the Controller chassis with 5V-1 of the PDB-ARTF05.
- Connect 5V-2 of the Controller chassis with 5V-2 of the PDB-ARTF05.

Each IO-rack uses a pair of PDC-ART05 cables to connect with the PDB-ARTF05:

- Connect WdP1.x of the PDB-ARTF05 with WdP1 of the IO-rack.
- Connect WdP2.x of the PDB-ARTF05 with WdP2 of the IO-rack.

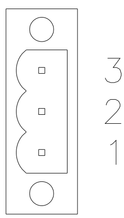
Pin allocation

The top view and pin allocation of the 5V-1 and 5V-2 connectors are:



	5V-1	5V-2
1	ground	ground
2	WD of CP1	WD of CP2
3	ground	ground
4	5V of CP1	5V of CP2

The top view and pin allocation of the WdPx connectors are:



	WdP1.x	WdP2.x
3	WD of CP1	WD of CP2
2	ground	ground
1	5V of CP1	5V of CP2

Technical data

General	Type numbers:	FC-PDB-ARTF05
	Approvals:	CE: UL,TUV,CSA pending
Power	• 5V-1: • 5V-2:	max. 16A max. 16A
Fuses	rating:	4 Amp / 58V
	type:	Littelfuse 142.6185.4406 (pink)
Connectors	5V-x:	4 pos, action pin,header
	WdPx.y:	3 pole, pin header
Physical	Module dimensions:	234 x 109 x 68 mm (L × W × H) 9.21 x 4.29 x 2.68 in (L × W × H)
	DIN EN rails:	TS32 / TS35 × 7.5
	Used rail length:	235 mm (9.25 in)

PDC-IOS05

Power Distribution Cable for a non-redundant IO chassis - 5 Vdc, Watchdog (Safety Manager)

Description

The PDC-IOS05 power distribution cable for a non-redundant IO chassis is used to transfer the (redundant) 5V of CP1 and CP2 (see Figure 47 on page 92) and the ‘second’ watchdog output of CP1 and CP2 (for non-redundant IO see Figure 155 on page 250) to a non-redundant IO chassis.

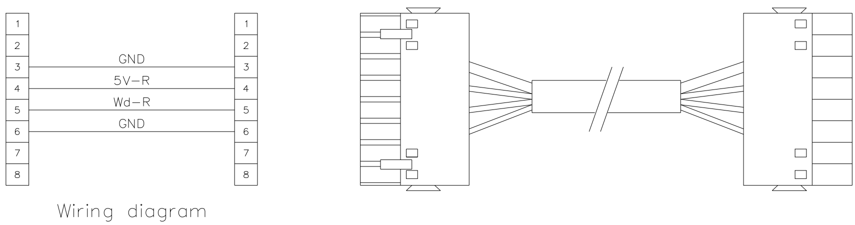
Attention

The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

Signals

Figure 534 Pin assignment and layout of the PDC-IOS05 cable

Signal	Connector pin	Wire color
GND	3	green/yellow (sleeved)
5V-R	4	brown
WD-R	5	blue
GND	6	black



Technical data

General	Type number:	FS-PDC-IOS05
	Approvals:	UL, CSA
Cable	Type:	SAB 2040415 CC600 4×1.5 mm^2
	Length:	2 m
Connectors	Type:	8 pole, pin header Weidmuller: BLC 5.08/8 BR
	Pins:	Weidmuller: DFFC 0.5 - 1.0 SN E

PDC-IOR05

Power Distribution Cable for a redundant IO chassis - 5 Vdc, Watchdog (Safety Manager)

Description

The PDC-IOR05 power distribution cable for a redundant IO chassis is used to transfer the 5V of CP1 and CP2 (see Figure 47 on page 92) and the watchdog outputs of CP1 and CP2 to a redundant IO chassis.

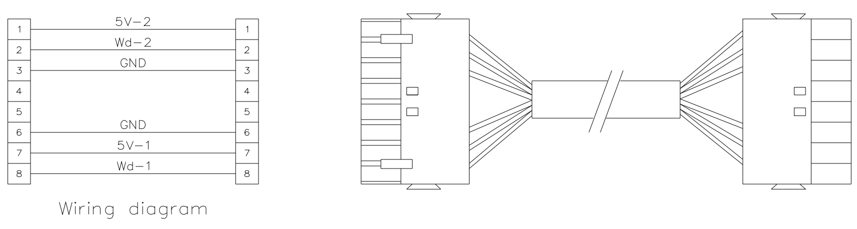
Attention

The connectors that are used on this cable can be sensitive to mechanical tension. Make sure that the cables are appropriately secured to avoid inadvertant disconnection.

Signals

Figure 535 Pin assignment and layout of the PDC-IOR05 cable

Signal	Connector pin	Wire indication
5V-2	1	‘1’ marking
WD-2	2	‘2’ marking
GND	3	‘3’ marking
GND	6	‘4’ marking
5V-1	7	‘5’ marking
WD-1	8	‘6’ marking



Technical data

General	Type number:	FS-PDC-IOR05
	Approvals:	UL, CSA
Cable	Type:	SAB 2040707 CC600 7 × 0.75 mm^2
	Length:	2 m
Connectors	Type:	8 pole, pin header Weidmuller: BLC 5.08/8 BR
	Pins:	Weidmuller: DFFC 0.5 - 1.0 SN E

PDC-IOX05-x

Power Distribution Cable for IO cabinets (5 Vdc, Watchdog)

Description

The PDC-IOX05-x power distribution cable for IO cabinets is used to transfer the 5V of CP1, CP2 or the redundant 5V (see Figure 47 on page 92) and the watchdog outputs of CP1, CP2 or the redundant watchdog (for non-redundant IO see Figure 155 on page 250) to an IO cabinet.

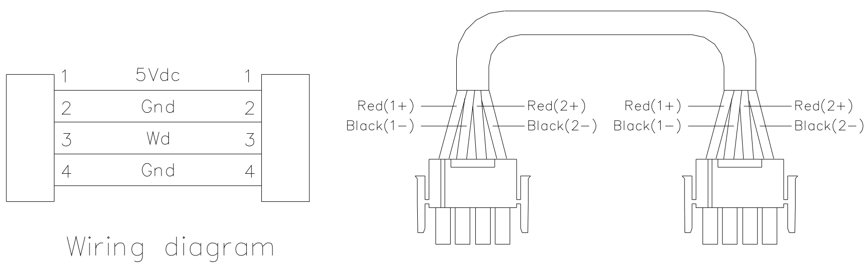
The PDC-IOX05-x cables are generally used in a set of three, to transfer all 5V and watchdog signals to the IO cabinet.

The PDC-IOX05-x cables run from the controller cabinet to the PDB-IOX05 board in the IO cabinet (see Figure 523 on page 824 and Figure 524 on page 824)

Signals

Figure 536 Pin assignment and layout of the PDC-IOX05-x cable

Signal	Connector pin	Wire indication
5V	1	red ‘1+’ marking
GND	2	black ‘1-’ marking
Watchdog	3	red ‘2+’ marking
GND	4	black ‘2-’ marking



Technical data

General	Type number:	FS-PDC-IOX05-1 (3.1 meter) FS-PDC-IOX05-2 (3.9 meter)
	Approvals:	UL, CSA
Cable	Type:	Special CC 600 World 4×2.5 mm^2
	Length:	3.1 / 3.9 m
Connectors	Type:	4 pole, mate-n-lock Tyco: 350779-1
	Pins:	Mate-n-lock crimp-socket Tyco: 350550-1

PDC-CPX05

Power Distribution Cable for controller cabinets (5 Vdc, Watchdog)

Description

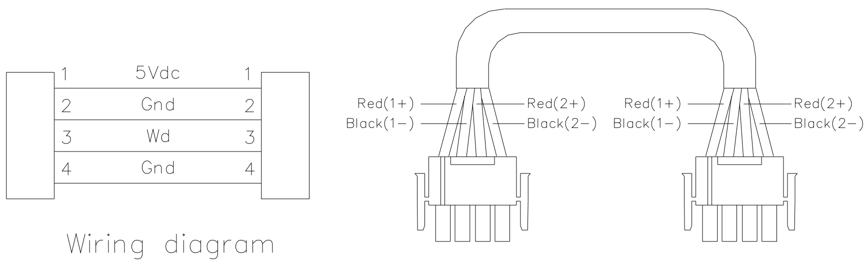
The PDC-CPX05 power distribution cables for controller cabinets are used to transfer the 5V of CP1, CP2 and the redundant 5V from the Controller chassis backplane to an PDB-CPX05 board.

The PDC-CPX05 cables are used in a set of three.

Signals

Figure 537 Pin assignment and layout of the PDC-CPX05 cable

Signal	Connector pin	Wire indication
5V	1	red ‘1+’ marking
GND	2	black ‘1-’ marking
Watchdog	3	red ‘2+’ marking
GND	4	black ‘2-’ marking



Technical data

General	Type number:	FS-PDC-CPX05
	Approvals:	UL, CSA
Cable	Type:	Special CC 600 World $4 \times 2.5\ mm^2$
	Length:	0.8 m
Connectors	Type:	4 pole, mate-n-lock Tyco: 350779-1
	Pins:	Mate-n-lock crimp-socket Tyco: 350550-1

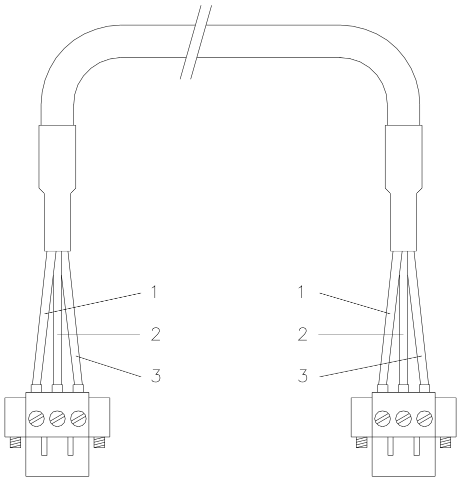
PDC-ART05

Power Distribution Cable for an IO chassis - 5 Vdc, Watchdog (Safety Manager A.R.T.)

Description

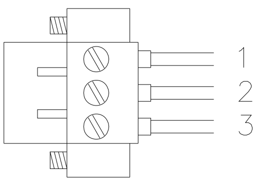
The PDC-ART05 power distribution cable for an IO chassis is used to transfer the 5V of CP1 or CP2 and the watchdog of CP1 or CP2 to the IO chassis (see “5 Volt and Watchdog distribution layout (Safety Manager A.R.T.)” on page 825).

Figure 538 Wire assignment of the PDC-ART05 cable



Signals

The pin assignment of the PDC-ART05 connectors is:

		WdP1.x	WdP2.x
	1	5V of CP1	5V of CP2
	2	ground	ground
	3	WD of CP1	WD of CP2

Technical data

General	Type number:	FS-PDC-ART05
	Approvals:	UL, CSA pending
Cable	Type:	SAB 02040415 CC600 4 × 1.5 mm^2
	Length:	2 m
Connectors	Type:	3 pole socket connector
	Make:	Weidmuller: BLZ 5.08/03/180F SN BK

List of abbreviations

AI	Analog Input
AO	Analog Output
ASM	Abnormal Situation Management
ATEX	Explosive Atmosphere (in French: "**AT**mospheres **EX**plosibles")
A.R.T.	Advanced Redundancy Technique
BKM	Battery and Key switch Module
BMS	Burner Management System
CDA	Common Data Access
CEE	Control Execution Environment
CP	Control Processor
DCF	Digital Coded Frequency
DCS	Distributed Control System
DI	Digital Input
DO	Digital Output
DTI	Diagnostic Test Interval
E/E/PES	Electrical/Electronic/Programmable Electronic System
EMC	Electromagnetic Compatibility
ESD	• ElectroStatic Discharge • Emergency ShutDown system
EUC	Equipment Under Control
EUT	Equipment Under Test
F&G	Fire and Gas
FB	Function Block
FDM	Field Device Management
FGS	Fire and Gas System
FLD	Functional Logic Diagram
FSC	Fail Safe Communication
FTA	Field Termination Assembly
FTE	Fault Tolerant Ethernet
GPS	Global Positioning System
HIPS	High-Integrity Protection Systems
HMI	Human Machine Interface
HSE	High Speed Ethernet

HSMS	Honeywell Safety Management Systems
IO	Input/Output
IP	• Internet Protocol • Ingress Protection
IS	Intrinsically Safe
LAN	Local Area Network
LED	Light-Emitting Diode
MAC	Media Access Control
MAP	Manufacturing Automation Protocol
MOS	Maintenance Override Switch
MTBF	Mean Time Between Failure
MTTF	Mean Time To Failure
MTTR	Mean Time To Repair
NTP	Network Time Protocol
OLE	Object Linking and Embedding
OLM	On-line Modification
OPC	Object linking and embedding for Process Control
OS	Operating System
P&ID	Piping and Instrumentation Diagram
PCDI	Peer Control Data Interface
PE	Protective Earth
PES	Programmable Electronic System
PFD	Probability of Failure on Demand
PKS	Process Knowledge System
PLC	Programmable Logic Controller
PST	Process Safety Time
PSU	Power Supply Unit
PTP	Precision Time Protocol
PUC	Process Under Control
PV	Process Value
QMR	Quadruple Modular Redundant
QPP	Quad Processor Pack
RFI	Radio Frequency Interference
RO	Relay Output (for descriptions use: potential free output contact)
SCADA	Supervisory Control And Data Acquisition

SCN	Software Change Notification (formerly addressed as *Release Note*)
SIC	System Interconnection Cable
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System
SMOD	Secondary Means Of De-energization
SOE	Sequence Of Events
SRS	Safety-Related System
SSC	Serial Communication Channel
STP	Shielded Twisted Pair
USI	Universal Safety Interface
UTP	Unshielded Twisted Pair
UTC	Coordinated Universal Time (Universal Time Coordinated)
WAN	Wide Area Network

Safety Manager Glossary

A

Alarm

An automatic signal that serves as a warning of an event or danger.

Application

The definition of the EUC-dependent function for Safety Manager.

Application Compiler

A tool of the Safety Builder used to create a controller file.

Application Editor

A tool of the Safety Builder used to create or edit functional logic diagrams.

Application value

The value of a process point as provided to, or calculated by, the application software.

Application version

A first or subsequent version of the application that is controlled in Safety Manager. An application version can have several states (see Application version state). An application version will be consolidated – or 'frozen' – when the application is loaded or published. The next change to the application will increment its version.

Application version state

A defined status of the application version. Safety Manager has a limited and controlled number of application version states to:

- enforce a useful sequence of activating program functions,
- enable control and/or comparison of application versions between connected components (i.e. Safety Builder, SM Controller, Experion).

Safety Manager uses these application version states:

state	meaning
Changed (Compile and Load Application needed)	changes to the application were made that *do* require loading to SM Controller
Changed (Publish Application needed)	changes to the application were made that *do not* require loading to SM Controller
Compiled	the application was successfully compiled

state	meaning
Published (load needed)	the application was compiled and subsequently published
Published (loaded)	the application was either; published (without compiling) or, loaded into the SM Controller

Application Viewer

A tool of the Safety Builder used to view functional logic diagrams on-line.

ATEX Directive

A directive which describes equipment and protective systems intended for use in potentially explosive atmospheres.

Safety Manager ATEX modules can be used for connection to hazardous locations in compliance with EN 60079-15:2005 (zone 2, sub groups IIA, IIB and IIC).

For more information see the *Safety Manager TUV EExn Approval Manual* (PM.MAN.8183)

Availability

- The ratio of system up time to total operating time.
- The ability of an item to perform its designated function when required for use.

B

Battery and Key switch Module (BKM)

A module in the SM Controller used to:

- Supply battery power to the system memory (RAM) and the real time clock of the Control Processor modules, in case of power outage.
- Enable or disable forces, by turning the Force key switch. When enabled, forcing of certain input and output signals is allowed. When disabled, all forces are removed.
- Provide a fault reset, by turning the Reset key switch. See Fault reset.

Warning

Turning the Reset key switch during an On-Line Modification procedure may cause the Control Processors to swap status.

C

Communication module

See: Universal Safety Interface (USI)

Communication redundancy fail-over

The automated capability of a device to switch over to a redundant or dormant communication path upon the failure or abnormal termination of the active path.

Communication time-out

An error caused by an unacceptable large time interval during which there was no communication.

Control Processor (CP)

Core component of the SM Controller consisting of: Power Supply Unit (PSU), Quadruple Processor Pack (QPP) and 1 or 2 communication modules (USI).

Control Processor states

A Control Processor (CP) can have many states. For fault detection and reaction the following states are relevant.

Attention:

The states described below are presented on the display of the relevant QPP, while the key switch of that QPP is in the **RUN** position.

- `Running` (without faults); CP is fully functional and executes the application.
- `Running with Flt` (with faults); CP executes the application but the controller detected one or more faults (e.g. open loop or a hardware fault).
- `Halt`; CP does not execute the application.

The applicable CP state can be read from the User Interface Display located on each Control Processor and from the diagnostic screens available on Experion™ and Safety Stations.

Controller chassis

19” chassis to slot the BKM and Control Processor modules.

Controller Management

A tool of the Safety Builder used to perform the following functions:

- Load controller.
- View system status.

- Retrieve controller and application files.

Coordinated Universal Time (UTC)

Also referred to as “Universal Time Coordinated” and “Zulu time”.

An atomic realization of Universal Time (UT) or Greenwich Mean Time (GMT), the astronomical basis for civil time. Time zones around the world are expressed as positive and negative offsets from UT. UTC differs by an integral number of seconds from atomic time and a fractional number of seconds from UT1.

Cycle time

The time period needed to execute the application software once.

D

Dangerous failure

Failure which has the potential to put the safety-related system in a hazardous or fail-to-function state.

Note

Whether or not the potential is realized may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a dangerous hardware failure is less likely to lead to the overall dangerous or fail-to-function state.

Deutsches Institut für Normung (DIN)

German Institute for Standards, which determines the standards for electrical and other equipment in Germany.

Diagnostic Test Interval (DTI)

The time period used by Safety Manager to cyclically locate and isolate safety related faults within on-line system components that could otherwise cause a hazardous situation.

With Safety Manager, the default DTI is set at 3 seconds. This setting needs to be verified for each process.

See also “Process safety time (PST)” on page 869.

Distributed Control System (DCS)

System designed to control industrial processes. A DCS receives the measured values of the process instrumentation, e.g. flow, pressure, temperature. It controls the process via analog control equipment such as control valves. In addition, a DCS may receive many digital signals for alarm and management purposes.

Dual Modular Redundant (DMR)

Safety configuration providing 1oo2 configuration. The DMR technology is used in the architecture of a non redundant QPP where on-board 1oo2D voting is based on dual-processor technology.

DMR is characterized by a high level of diagnostics and fault coverage.

E

Electrical/Electronic/Programmable Electronic (E/E/PE) device

A device based on electrical (E) and/or electronic (E) and/or programmable electronic (PE) technology.

Note

This term is intended to cover any and all devices operating on electrical principles and would include:

- electro-mechanical devices (“electrical”);
- solid state non-programmable electronic devices (“electronic”);
- electronic devices based on computer technology (“programmable electronic”).

Electrical/Electronic/Programmable Electronic system (E/E/PES)

A system based on one or more E/E/PE devices, connected to (and including) input devices (e.g. sensors) and/or output devices/final elements (e.g. actuators), for the purpose of control, protection or monitoring.

See also: “Programmable electronic system (PES)” on page 869.

Electromagnetic Compatibility (EMC)

The ability of a device, equipment or system to function satisfactory in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

ElectroStatic discharge (ESD)

The transfer of electrostatic charge between bodies of different electrostatic potential, which may cause damage to system components.

Emergency ShutDown (ESD)

Manual or automatic turning off or closing down of process equipment in case of anomalous conditions in order to prevent damage to the system or process.

EUC risk

Risk arising from the EUC or its interaction with the EUC control system.

See also “Equipment Under Control (EUC)” on page 858.

Equipment Under Control (EUC)

Equipment/machinery/apparatus/Plant used for manufacturing, process, transportation, medical or other activities for which designated safety-related systems could be used to:

- prevent hazardous events associated with the EUC from taking place; or,
- mitigate the effects of the hazardous events.

Error

Discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition.

Ethernet

A local area network specification developed by Xerox in 1976. The specification served as the basis for the IEEE 802.3 standard, which specifies the physical and lower software layers of the network. It uses CSMA/CD to handle simultaneous transmissions and is the most popular LAN Technology is use today.

See also: Local Area Network (LAN).

Event

- Occurrence of some programmed action within a process which can affect another process.
- Asynchronous occurrence that is detected by the control system, time and other information is recorded, e.g. process alarm.

Experion PKS

Honeywell Process Knowledge System™ for process, business and asset management.

Experion Station

Windows based station for viewing process schematics and interactions with the system. This station provides comprehensive alarm and event detection, management, reporting facilities, and history collection along with the capability of custom process graphics.

Event collection & management system

A device used to collect, log and manage sequence of events (SOE) data.

See also: Safety Historian and Sequence Of Events (SOE).

External device

A generic term for a system the SM Controller is communicating with. This may be an Experion server, a Modbus device, a Safety Station or even another SM Controller. Also known as third party device.

External risk reduction measures

Physical measures taken externally to safety-related systems to reduce or mitigate the risks. Examples would include a drain system, fire wall, etc.

F

Fail-over

See “Communication redundancy fail-over” on page 855.

Failure

The termination of the ability of a functional unit to perform a required function.

Note

- The definition in IEV 191-04-01 is the same, with additional notes.
- See figure in “Functional Safety” for the relationship between faults and failures, both in IEC 61508 and IEV 191.
- Performance of required functions necessarily excludes certain behavior, and some functions may be specified in terms of behavior to be avoided. The occurrence of such behavior is a failure.
- Failures are either random (in hardware) or systematic (in hardware or software).

Fault

Abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function.

Note

IEV 191-05-01 defines “fault” as a state characterized by the inability to perform a required function, excluding the inability during preventative maintenance or other planned actions, or due to lack of external resources.

Fault reaction

The reaction to faults in the Controller, application and/or IO.

- The fault reaction towards Controller and/or application faults is fixed.
- The fault reaction to IO faults can be configured on a point or module level; it should be customized to the application for which Safety Manager is used.

See also “IO states” on page 864.

Fault reset

An action that clears the fault database and attempts a restart of tripped or halted components of the system.

Fault Tolerant Ethernet (FTE)

An Ethernet based control network of Experion PKS.

FC

Prefix used to identify conformal-coated module from non conformal coated modules. See also: FS.

- FC-SDI-1624 is a safe digital input module with conformal coating
- FS-SDI-1624 is a safe digital input module without conformal coating

Field Termination Assembly (FTA)

Assembly to connect field wiring to the SM chassis IO modules.

Field value

The value of a process point as present at the interface of the system with the EUC.

Fieldbus

Wiring solution and communication protocol in which multiple sensors and actuators are connected to a DCS or SIS, using a single cable.

Fire and Gas system

Independent protective system which continuously monitors certain process points (e.g. combustible gas levels) and environmental points (e.g. heat, smoke, temperature and toxic gas levels). If any of these points exceed a predetermined level, the system will raise an alarm and take automatic action to close operating valves and damper doors, activate extinguishers, cut off electrical power and vent dangerous gases.

Force

A signal override of some sort that is applied on a system level.

A force applied to an input affects the input application state as it overrides the actual field value and diagnostic state of the forced input.

A force applied to an output affects the output field state as it overrides the application value or diagnostic value with the forced value.

Caution

Forcing introduces a potentially dangerous situation as the corresponding point could go unnoticed to the unsafe state while the force is active.

FS

Prefix used to identify non conformal-coated module from conformal coated modules. See also: FC.

- FS-SDI-1624 is a safe digital input module without conformal coating
- FC-SDI-1624 is a safe digital input module with conformal coating

Function block

Element in a functional logic diagram (FLD) which performs a user defined logic function. Function blocks are designed to implement & re-use complex functions via a single (user defined) element.

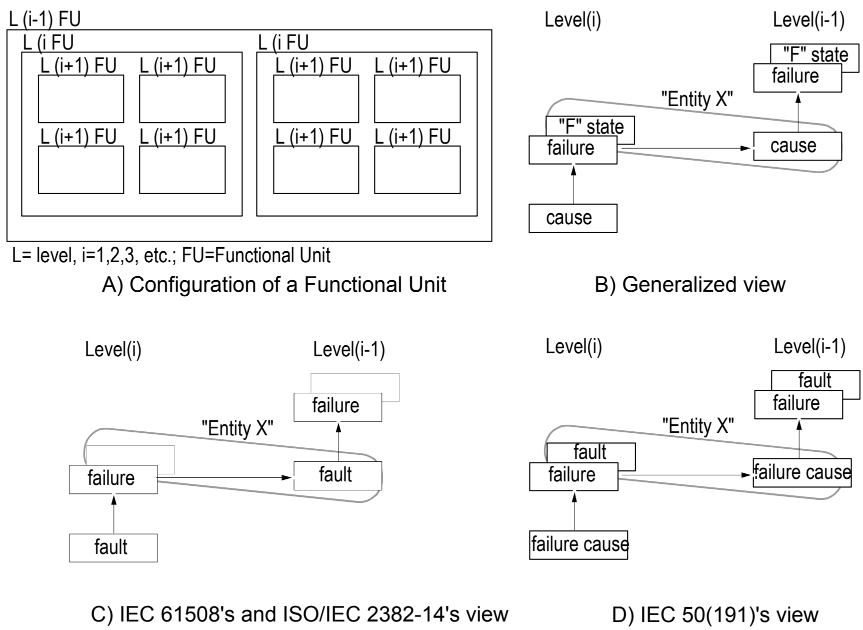
Functional Logic Diagram (FLD)

Diagrammatic representation of the application (conform the IEC 61131-3 standard) which is used to program Safety Manager. FLDs are directly translated into code that can be executed by Safety Manager, thus eliminating the need for manual programming. See also: Application Editor.

Functional safety

Part of the overall safety relating to the EUC and the EUC control system which depends on the correct functioning of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities.

Figure 539 Failure model



Notes for Figure 539 on page 861

- As shown in A), a functional unit can be viewed as a hierarchical composition of multiple levels, each of which can in turn be called a functional unit. In level (i), a “cause” may manifest itself as an error (a deviation from the correct value or state) within this level (i) functional unit, and, if not corrected or circumvented, may cause a failure of this functional unit, as a result of which it falls into an “F” state where it is no longer able to perform a required function (see B)). This “F” state of the level (i) functional unit may in turn manifest itself as an error in the level (i-1) functional unit and, if not corrected or circumvented, may cause a failure of this level (i-1) functional unit.
- In this cause and effect chain the same thing (“Entity X”) can be viewed as a state (“F” state) of the level (i) functional unit into which it has fallen as a result of its failure, and also as the cause of the level (i-1) functional unit. This “Entity X” combines the concept of “fault” in IEC 61508 and ISO/IEC 2382-14, which emphasizes its cause aspect as illustrated in C), and that of “fault” in IEC 50(191), which emphasizes its state aspect as illustrated in D). The “F” state is called fault in IEC 50(191), whereas it is not defined in IEC 61508 and ISO/IEC 2382-14.
- In some cases, a failure may be caused by an external event such as lightning or electrostatic noise, rather than by an internal fault. Likewise, a fault (in both vocabularies) may exist without a prior failure. An example of such a fault is a design fault.

Functional safety assessment

Investigation, based on evidence, to judge the functional safety achieved by one or more E/E/PE safety-related systems, other technology safety-related systems or external risk reduction facilities.

H

Hardware Configurator

A tool of the Safety Builder used to configure the hardware of Safety Manager.

Hardware safety integrity

Part of the safety integrity of the Safety Instrumented Systems (SIS) relating to random hardware failures in a dangerous mode of failure.

Note

The term relates to failures in a dangerous mode. That is, those failures of a safety-related system that would impair its safety integrity. The two parameters that are relevant in this context are the overall dangerous failure rate and the probability of failure to operate on demand. The former reliability parameter is used when it is necessary to maintain continuous control in order to maintain safety, the latter reliability parameter is used in the context of safety-related protection systems.

Hazard

A physical situation with a potential for human injury.

Note

The term includes danger to persons arising within a short time scale (e.g. fire and explosion) and also those that have a long-term effect on a persons health (e.g. release of a toxic substance).

High voltage

A voltage of 30VAC, 40VDC or above.

Human error

Mistake.

Human action or inaction that produces an unintended result.

I

IEC 61131-3

Part of the international standard IEC 61131, which provides a complete collection of standards on programmable controllers and their associated peripherals.

The IEC 61131-3 specifies the syntax and semantics of programming languages for programmable controllers as defined in part 1 of IEC 61131 (FLD symbols).

IEC 61508

International IEC standard on functional safety entitled “Functional safety: safety-related systems”, which sets out a generic approach for all electrically based systems that are used to perform safety functions. A major objective of this international standard is to facilitate the development of application sector standards.

Institute of Electrical and Electronic Engineers (IEEE)

An American professional organization of scientists and engineers whose purpose is the advancement of electrical engineering, electronics and allied branches of engineering and science. It also acts as a standardization body.

International Electrotechnical Commission (IEC)

An international standards development and certification group in the area of electronics and electrical engineering, including industrial process measurement, control and safety.

Interval time between faults

See: Repair timer.

IO bus

A bus-structure within Safety Manager that interconnects the Control Processor with the IO.

IO bus driver

Part of the Quad Processor Pack that controls the IO bus.

IO chassis

19” chassis to slot the (redundant) IO extender(s) and SM chassis IO modules.

IO database

Database in which input, output and configuration data is stored.

IO extender

Module which controls the IO bus of the IO chassis. A maximum of ten IO extender modules can be connected to one IO bus.

IO module

An IO module is always chassis-mounted within a Safety Manager cabinet. This type of module handles input or output functions of Safety Manager. IO modules can be digital or analog.

IO states

From a system point of view, IO can have either the healthy state, the de-energized state or the fault reaction state.

- When healthy, the IO is active and has the application value applied.
- When de-energized, the IO is de-activated (as if no power was supplied).
- When the fault reaction state is applied, the IO responds according to a predefined fault condition (fault reaction).
- When forced, the force value is applied.

L

Local Area Network (LAN)

A general term to refer to the network and its components that are local to a particular set of devices.

See also: Wide area network (WAN).

M

Maintenance override

A function, which allows the user to apply an application value to an input independent of the input channel scan value.

Maintenance Override Switch (MOS)

Switch used to file a request for a maintenance override. Acknowledgement is decided by the application program. An acknowledged maintenance override allows maintenance to be performed on field sensors or field inputs without causing the safety system to shutdown the process.

Master-clock source

The source that is responsible for the time synchronization between a group of systems or within a network.

Mean Time Between Failure (MTBF)

- For a stated period in the life of a functional unit, the mean value of the length of time between consecutive failures under stated conditions.
- The expected or observed time between consecutive failures in a system or component.

MTBF is used for items which involve repair.

See also: Mean Time To Repair (MTTR), Mean Time To Failure (MTTF).

Mean Time To Failure (MTTF)

The average time the system or component of the system works without failing.

MTTF is used for items with no repair.

See also: Mean Time To Repair (MTTR), Mean Time Between Failure (MTBF).

Mean Time To Repair (MTTR)

The mean time to repair a safety-related system, or part thereof. This time is measured from the time the failure occurs to the time the repair is completed.

Media Access Control (MAC)

The lower sublayer of the data link layer (Layer 2) unique to each IEEE 802 local area network. MAC provides a mechanism by which users access (share) the network.

Modbus

A communications protocol, based on master/slave or Node ID/Peer ID architecture, originally designed by Modicon for use with PLC and SCADA systems. It has become a de facto standard communications protocol in industry, and is now the most commonly available means of connecting industrial electronic devices.

Mode of operation

Way in which a safety-related system is intended to be used, with respect to the frequency of demands made upon it in relation to the proof check frequency, which may be either:

- **Low demand mode** - where the frequency of demands for operation made on a safety-related system is not significantly greater than the proof check frequency; or
- **High demand or continuous mode** - where the frequency of demands for operation made on a safety-related system is significantly greater than the proof check frequency.

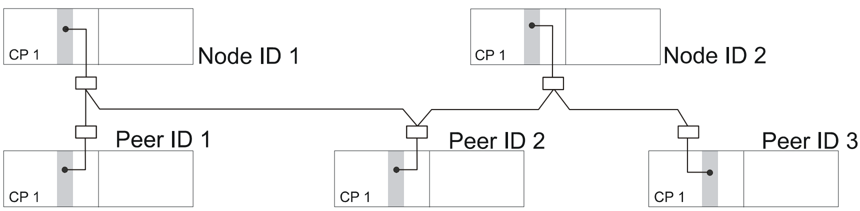
Note

Typically for low demand mode, the frequency of demands on the safety-related system is the same order of magnitude as the proof test frequency (i.e. months to years where the proof test interval is a year). While typically for high demand or continuous mode, the frequency of demands on the safety-related system is hundreds of times the proof test frequency (i.e. minutes to hours where the proof test interval is a month).

Multidrop link

A multidrop link is a physical link that interconnects multiple systems (see Figure 540 on page 866).

Figure 540 Example of a multidrop connection based on Ethernet



N

Namur

A 2-wire proximity switch operating at a working voltage of 8.2 V and an operating current of 8mA max (CENELEC Standard). Because of the small amount of energy needed to operate NAMUR sensors, they can be used in intrinsically safe applications.

Note

Special switching amplifiers or dedicated input modules, like the SDIL-1608, are required to read the status of NAMUR proximity switches.

Network Configurator

A tool of the Safety Builder used to configure the communication architecture.

Network Time Protocol (NTP)

See "Time protocol" on page 879.

Node

Hardware entity connected to a network.

Node ID

- A communication initiator on an Ethernet network. Counterpart of a Peer ID (see "Peer ID" on page 868).
- The address or ID number of a node. (See "Node" on page 867).

O

Object linking and embedding for Process Control (OPC)

Technology developed originally by Microsoft, now being standardized. Microsoft technology for application interoperability. Object Linking and Embedding (OLE) is a set of services that provides a powerful means to create documents consisting of multiple sources of information from different applications. Objects can be almost any type of information, including text, bitmap images, vector graphics, voice, or video clips.

Off-line

A system is said to be "off-line" when it is not in active control of equipment or a process.

A process or equipment is said to be "off-line" when it is in shut-down.

On-line

A system is said to be "on-line" when it is in active control of equipment or a process.

A process or equipment is said to be "on-line" when it is operating.

Operating temperature

The temperature a system and its modules are operating on.

For systems it represents the temperature within the cabinet. For modules in general it represents the temperature outside the module in its direct vicinity. For specific modules (i.e. QPP and universal modules) operating temperature is specified as 'outside' and 'inside' module temperature.

In Safety Manager cabinets temperature monitoring is done in the CP chassis within the QPP module. For remote IO locations (e.g. remote cabinets) temperature monitoring is done within the universal module(s).

Operational state

The values of an application point during normal process operation.

P

Peer Control Data Interface (PCDI)

A Honeywell licensed communication interface for non-safe peer-to-peer data communication between (Experion) Process controllers and SM Controllers.

Peer ID

A responder in Ethernet communication. Counterpart of a Node ID (See "Node ID" on page 867.)

Peer-to-peer

A logical connection between two points.

Plant

A component in Safety Builder which contains devices, controllers as well as physical and logical communication configurations used to interconnect these devices and controllers.

Point

A data structure in the IO database, usually containing information about a field entity. A point can contain one or more parameters. Safety Manager uses different point types to represent a range of different field values.

Point Configurator

A tool of the Safety Builder used to create and modify points of a SM Controller.

Point Viewer

A tool of the Safety Builder used to view points with dynamic update of states and values.

Power Supply Unit (PSU)

Separate module which supplies electrical power to the Safety Manager.

Precision Time Protocol (PTP)

See “Time protocol” on page 879

Probability of Failure on Demand (PFD)

A value that indicates the probability of a system failing to respond to a demand. PFD equals 1 minus Safety Availability. (ISA, S84.01, 1996)

Process safety time (PST)

The time a process can be left running uncontrolled without loosing the ability to regain control.

See also: Diagnostic Test Interval (DTI).

Process states

A process can have many states. Related to fault detection and reaction in the safety loop of a process, the following process states are described:

- running without detected faults
- running with detected faults
- halted

Process value

An amount, expressed in engineering units, that represents the value of a process variable, e.g. a temperature, a pressure or a flow.

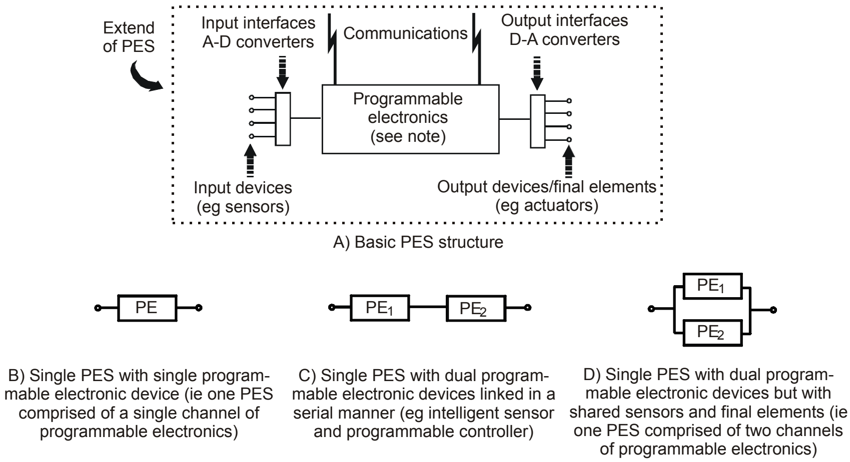
Programmable electronic system (PES)

System for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices (see Figure 541 on page 870).

Note

The structure of a PES is shown in Programmable electronic system (PES): structure and terminology A). Programmable electronic system (PES): structure and terminology B) illustrates the way in which a PES is represented in IEC 61508, with the programmable electronics shown as a unit distinct from sensors and actuators on the EUC and their interfaces, but the programmable electronics could exist at several places in the PES. Programmable electronic system (PES): structure and terminology C) illustrates a PES with two discrete units of programmable electronics. Programmable electronic system (PES): structure and terminology D) illustrates a PES with dual programmable electronics (i.e. two channel), but with a single sensor and a single actuator.

Figure 541 Programmable electronic system (PES): structure and terminology



Q

Quad Processor Pack (QPP)

The main processing module of the SM Controller.

Quadruple Modular Redundant (QMR)

Safety configuration providing a 2oo4D configuration. The QMR technology is used in the architecture of a redundant QPP where on-board 1oo2D voting (see Dual Modular Redundant (DMR)) is combined with 1oo2D voting between the two QPPs.

Voting takes place on two levels: First on a module level and secondly between the Control Processors.

QMR is characterized by a high level of diagnostics, fault coverage and fault tolerance.

R

Redundancy

- In an item, the existence of more than one means of performing a required function.
- Use of duplicate (or triple or quadruple) modules or devices to minimize the chance that a failure might disable an entire system.

Repair time

The time allowed to keep a Safety Instrumented System (SIS) running with a fault present that “may affect safety upon accumulation of multiple faults”. Repair time is introduced to extend the SIS up-time for a limited time frame, allowing system repair.

Repair timer

A configurable count-down timer triggered upon detection of a fault that minimizes the safety availability of the system.

The default repair window is 200 hours, which is more than sufficient if spare parts are available. The repair timer can be deactivated.

Each Control Processor has its own repair timer. Once running, a repair timer shows the remaining time to repair the fault that triggered the repair timer in the Control Processor (200 hours default). If the fault is not repaired within the repair time the Control Processor containing the fault halts.

A repair timer protects the system from certain fault accumulations that may affect the safety of Safety Manager. The timer only starts on detection of:

- faults on output modules with fault reaction set to `Low`
- faults detected with non-redundant IO bus extenders.

Reset

See: Fault reset.

Risk

Combination of the probability of occurrence of harm and the severity of that harm.

Router

A network device which forwards packets (messages or fragments of messages) between networks.

The forwarding decision is based on network layer information and routing tables, often constructed by routing protocols.

S

Safe

A design property of an item in which the specified failure mode is predominantly in a safe direction.

Safe failure

Failure which does not have the potential to put the safety-related system in a hazardous or fail-to-function state.

Note

Whether or not the potential is realized may depend on the channel architecture of the system; in systems with multiple channels to improve safety, a safe hardware failure is less likely to result in an erroneous shutdown.

SafeNet

A SIL3 network protocol used by Safety Manager for i.e. safe data exchange between Safety Managers.

Safety

Freedom from unacceptable risk.

Safety Availability

The fraction of time (%) that a safety system is able to perform its designated safety service when the process is operating. See also Probability of Failure on Demand (PFD).

Safety Builder

- Station software used to configure, design, validate, log and monitor a Safety Manager project.
- Protocol used by Safety Manager to communicate with Safety Stations.

Safety Historian

Sequence of events collecting device. Windows-based software tool used to record, view and process sequence of events (SOE) data. SOE data is stored in a database for (re-)use at a later stage.

See also: Event collection & management system and Sequence Of Events (SOE).

Safety Instrumented Function (SIF)

A Safety Instrumented Function (SIF) is an isolated function, initially designed to protect “life and limb” against a specific hazard. A more popular term for SIF is safety loop. Each SIF operates on its own Safety Integrity Level.

See also: Safety instrumented System (SIS) and Safety integrity level (SIL).

Safety instrumented System (SIS)

A Safety Instrumented System (SIS) is a system that executes one or more SIFs. The various SIFs inside a SIS may each require a different Safety Integrity Level.

A SIS should be able to support all SIFs, including the one with the highest SIL level.

See also: Safety Instrumented Function (SIF) and Safety integrity level (SIL).

Safety integrity

Probability of a safety-related system to satisfactorily perform the required safety functions under all stated conditions within a stated period of time.

Safety integrity level (SIL)

Discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest.

Note

- The target failure measures for the safety integrity levels are specified in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation and Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation.

Table 88 Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation

Safety integrity level	Low demand mode of operation (average probability of failure to perform its design function on demand)
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$
NOTE: see notes below for details on interpreting this table.	

Table 89 Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation

Safety integrity level	High demand or continuous mode of operation (probability of a dangerous failure per hour)
4	$\geq 10^{-9}$ to $< 10^{-8}$
3	$\geq 10^{-8}$ to $< 10^{-7}$

Table 89 Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation *(continued)*

Safety integrity level	High demand or continuous mode of operation (probability of a dangerous failure per hour)
2	$\geq 10^{-7}$ to $< 10^{-6}$
1	$\geq 10^{-6}$ to $< 10^{-5}$
NOTE: see notes below for details on interpreting this table.	

Note

1. The parameter in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation, probability of a dangerous failure per hour, is sometimes referred to as the frequency of dangerous failures, or dangerous failure rate, in units of dangerous failures per hour.
2. This document sets a lower limit on the target failure measures, in a dangerous mode of failure, than can be claimed. These are specified as the lower limits for safety integrity level 4 (that is an average probability of failure of 10^{-5} to perform its design function on demand, or a probability of a dangerous failure of 10^{-9} per hour). It may be possible to achieve designs of safety-related systems with lower values for the target failure measures for non-complex systems, but it is considered that the figures in the table represent the limit of what can be achieved for relatively complex systems (for example programmable electronic safety-related systems) at the present time.
3. The target failure measures that can be claimed when two or more E/E/PE safety-related systems are used may be better than those indicated in Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in low demand mode of operation and Safety integrity levels: target failure measures for a safety function, allocated to the Safety Instrumented System operating in high demand or continuous mode of operation providing that adequate levels of independence are achieved.
4. It is important to note that the failure measures for safety integrity levels 1, 2, 3 and 4 are target failure measures. It is accepted that only with respect to the hardware safety integrity will it be possible to quantify and apply reliability prediction techniques in assessing whether the target failure measures have been met. Qualitative techniques and judgements have to be made with respect to the precautions necessary to meet the target failure measures with respect to the systematic safety integrity.
5. The safety integrity requirements for each safety function shall be qualified to indicate whether each target safety integrity parameter is either:

- the average probability of failure to perform its design function on demand (for a low demand mode of operation); or
- the probability of a dangerous failure per hour (for a high demand or continuous mode of operation).

Safety life cycle

Necessary activities involved in the implementation of safety-related systems, occurring during a period of time that starts at the concept phase of a project and finishes when all of the E/E/PE safety-related systems, other technology safety-related systems and external risk reduction facilities are no longer available for use.

Safety Manager

A safety solution to protect the integrity of a Process Under Control (PUC) and/or Equipment Under Control (EUC) in accordance with IEC 61508.
Assuming a full range configuration, Safety Manager includes the following components:

- SM Controller
- SM chassis IO
- SM universal IO
- Field interfaces (e.g. FTA's, cabling)

Safety Station is used to control and configure Safety Manager, and to enable communication with other applications.

For details see the *Overview Guide*.

Safety Manager A.R.T.

Safety Manager with Advanced Redundancy Technique. Safety Manager A.R.T. uses specific hardware in a dedicated architecture and has extended availability compared to Safety Manager. Safety Manager A.R.T. has the capability to continue normal operation with a combination of a Control Processor fault and an IO fault.

Safety related

A flag to indicate that a signal is used for a safe function.

See also: Safe and Safety-related system.

Safety-related system

Designated system that both:

- implements the required safety functions necessary to achieve or maintain a safe state for the EUC, and
- is intended to achieve, on its own or with other E/E/PE safety-related systems, other technology safety-related systems or external risk reduction facilities, the necessary safety integrity for the required safety functions.

Note

1. The term refers to those systems, designated as safety-related systems, that are intended to achieve, together with the external risk reduction facilities, the necessary risk reduction in order to meet the required tolerable risk.
2. The safety-related systems are designed to prevent the EUC from going into a dangerous state by taking appropriate action on receipt of commands. The failure of a safety-related system would be included in the events leading to the identified hazard or hazards. Although there may be other systems having safety functions, it is the safety-related systems that have been designated to achieve, in their own right, the required tolerable risk. Safety-related systems can broadly be divided into safety-related control systems and safety-related protection systems, and have two modes of operation.
3. Safety-related systems may be an integral part of the EUC control system or may interface with the EUC by sensors and/or actuators. That is, the required safety integrity level may be achieved by implementing the safety functions in the EUC control system (and possibly by additional separate and independent systems as well) or the safety functions may be implemented by separate and independent systems dedicated to safety.
4. A safety-related system may:

- be designed to prevent the hazardous event (that is if the safety-related systems perform their safety functions then no hazard arises). The key factor here is the ensuring that the safety-related systems perform their functions with the degree of certainty required (for example, for the specified functions, that the average probability of failure should not be greater than 10^{-4} to perform its design function on demand).
- be designed to mitigate the effects of the hazardous event, thereby reducing the risk by reducing the consequences. As for the first item in this list, the probability of failure on demand for the specified functions (or other appropriate statistical measure) should be met.
- be designed to achieve a combination of both kinds of systems.

5. A person can be part of a safety-related system. For example, a person could receive information from a programmable electronic device and perform a safety task based on this information, or perform a safety task through a programmable electronic device.
6. The term includes all the hardware, software and supporting services (for example power supplies) necessary to carry out the specified safety function (sensors, other input devices, final elements (actuators) and other output devices are therefore included in the safety-related system).
7. A safety-related system may be based on a wide range of technologies including electrical, electronic, programmable electronic, hydraulic and pneumatic.

Safety Station

Station running Safety Builder to control and configure Safety Manager. Safety Station can also run one or more other applications to manage loggin and communication.
Examples are: Safety Historian, Trip & Bypass management, communication with plant control systems.

Second fault timer

See: Repair timer.

Secondary Means

A means designed to drive towards a safe state in case the primary means is unable or unreliable to do so.

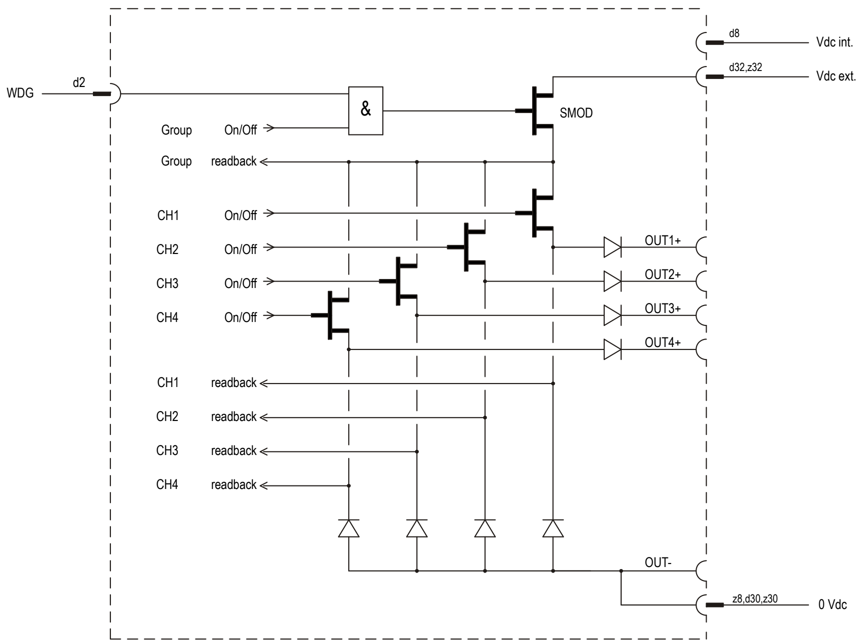
An example of a secondary means is the watchdog: The watchdog is designed to drive the Control Processor and related outputs to a safe state if the Control Processor itself is unable or unreliable to do so.

Secondary Means Of De-energization (SMOD)

A SMOD is a Secondary Means designed to de-energize the output in case the primary means is unable or unreliable to do so.

Figure 542 on page 877 shows an example of a SMOD protecting 4 output channels.

Figure 542 Schematic diagram of a SMOD with 4 channels



Sequence Of Events (SOE)

The function detecting the occurrence of events. See also: Safety Historian and Event collection & management system.

Serial communication

Communication that is based on either an RS232, RS422 or RS485 link.

Shutdown

A process by which an operating Plant or system is brought to a non-operational state.

SICC

IO signal wiring using system interconnection cables that hook up the FTA board to the IO.

SICP

IO signal wiring using system interconnection cables that hook up the screw terminals to the IO.

Single fault tolerant

Built-in ability of a system to correctly continue its assigned function in the presence of a single fault in the hardware or software.

Single fault tolerant for safety

Built-in ability of each Safety Manager configuration to continue to maintain safety in the presence of a single fault in the hardware or software.

SM Controller

Assembly of Control Processor, Controller chassis and BKM. A Controller can be redundant or non redundant. A redundant Controller contains two Control Processors. A non redundant Controller contains one Control Processor. Note that IO is not included.

SM chassis IO

SM chassis IO stands for Safety Manager chassi based IO. This type of IO is always chassis-mounted within a Safety Manager cabinet. This type of IO is also called ‘chassis IO’.

SM universal IO

SM universal IO stands for Safety Manager universal IO. This type of IO is IOTA-mounted in remote locations and/or within a Safety Manager cabinet.

SM RIO Link

A real-time communication IO-bus that uses a dedicated protocol for safe exchange of IO data between an SM Controller and one or more universal IO modules.

SM universal IO module

An SM universal IO module is a Remote Universal Safe device. It has multiple channels that can be configured individually depending on system needs. An SM universal IO module is placed on an IOTA.

Typical SM universal IO modules are:

- RUSIO modules
- RUSLS modules

Storage temperature

The temperature the system can be stored at.

Switch

A network device which forwards packets (messages or fragments of messages) by means of packet switching.

The forwarding decision is based on the most expedient route (as determined by some routing algorithm). Not all packets travelling between the same two hosts, even those from a single message, will necessarily follow the same route.

System Interconnection Cable (SIC)

Cables to connect IO modules with FTAs or terminals.

Systematic safety integrity

Part of the safety integrity of safety-related systems relating to systematic failures in a dangerous mode of failure.

Note

Systematic safety integrity cannot usually be quantified (as distinct from hardware safety integrity which usually can).

T

Third party device

See “External device” on page 858.

Time protocol

A collective for Internet protocols to provide machine readable date and time:

- The Precision Time Protocol (PTP) is a protocol that allows precise synchronization of networks. It is used in SafeNet where it reaches clock synchronization accuracies of 10ms.

- The Network Time Protocol (NTP) is an older protocol for synchronizing the clocks of computer systems over internet/ethernet. Safety Manager supports NTP3 and NTP4, reaching clock synchronization accuracies of 100ms.

Timestamp

As a verb, the act of putting the current time together with an event. As a noun, the time value held with an event.

Trend

A display defined primarily for presentation of and navigation through historical information.

Trip

An action by which part of an operating Plant or system is brought to a non-operational state.

See also: Shutdown.

Triple Modular Redundant (TMR)

Safety technology which is based on comparison principles and which requires triplicated system components.

U

Universal Safety Interface (USI)

Communication module of the SM Controller.

V

Validation

Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification

Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled.

Note

In the context of IEC 61508, verification means the process of demonstrating for each phase of the relevant safety lifecycle (overall, E/E/PES, software), by analysis and/or tests, that, for the specific inputs, the deliverables meet in all respects the objectives and requirements set for the specific phase.

Examples of verification activities would include:

1. Reviews on deliverables (documents from all phases of the safety lifecycle) to ensure compliance with the objectives and requirements of the phase taking into account the specific inputs to that phase.
2. Design reviews.
3. Tests performed on the designed products to ensure that they perform according to their specifications.
4. Integration tests performed where different parts of a system are put together in a step-by-step manner and by the performance of environmental tests to ensure that all the parts work together in the specified manner.

Voting configuration

To prevent that a safety-related system remains passive or false signals occur in this system it is possible to use voting. With voting the safety-related system makes a decision based on signals. The usage of more than one signal enhances the safety and reliability of the system.

W

Watchdog

A combination of diagnostics and an output device (typically a switch) the aim of which is to monitor the correct operation of the programmable electronic (PE) devices and takes action upon detection of an incorrect operation.

Note

The watchdog is used to de-energize a group of safety outputs when dangerous failures are detected in order to put the EUC into a safe state. The watchdog is used to increase the on-line diagnostic coverage of the logic system

Wide area network (WAN)

A general term to refer to a piece of a network and its components that are used to inter-connect multiple LANs over a wide area.

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